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HARNESSING OUR WATER POWER
A FORWARD STEP IN AUTOMOTIVE FUELS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

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HOW THE WEST IS PUTTING ITS WATER POWER TO WORK.— (See page 514)

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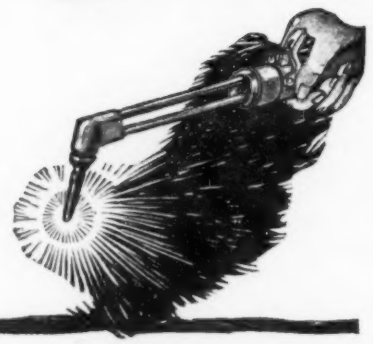

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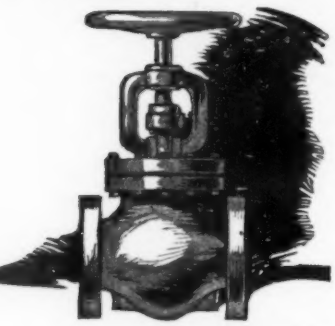

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SEVENTY-SIXTH YEAR

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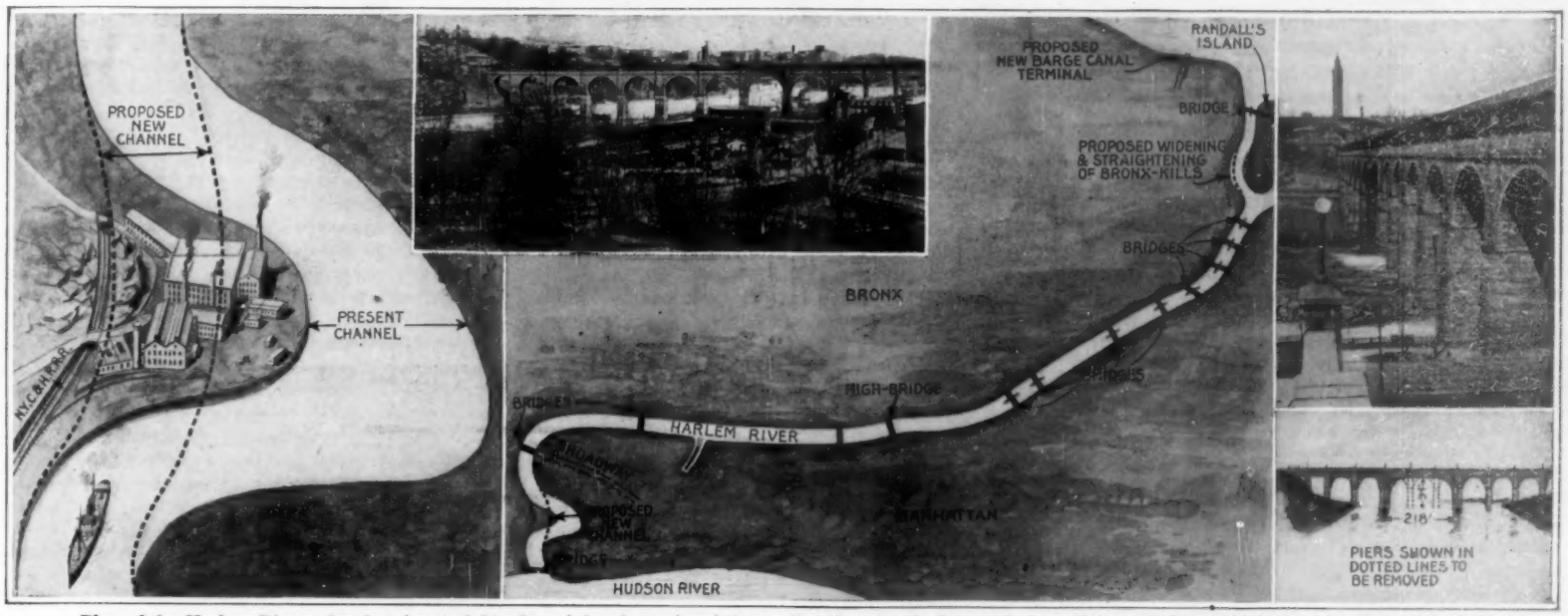

Plan of the Harlem River, showing the straightening of the channel and the projected removal of several piers of the aqueduct, which now obstruct navigation

Opening Up the Harlem River

Famous New York Waterway to be Relieved of Obstructions and Deepened to 14 Feet

THE Barge Canal Terminal Act of 1911 provides for the establishment of a terminal at 136th Street and East River, New York, in the Bronx, but with the proviso that the work of construction shall not be undertaken unless and until the Federal Government widens and deepens the Bronx Kills, so that traffic may pass to and from the Harlem River into the East River, and avoid the present circuitous and dangerous route through Hell Gate.

The Federal Government has had this under consideration since the early '80s, but the present attitude is that the dredging will not be undertaken until the City of New York shall have taken steps to remove the obstructions to navigation at High Bridge, and the attitude of the city has heretofore been that it was useless to do this unless and until the State has procured and transferred the necessary right of way at the Johnson Iron Works for the rectification of the channel in the Harlem River at Spuyten Duyvil. The Dock Commissioner has labored incessantly through his two terms in Congress and his present term of Dock Commissioner to bring this about.

The Legislature of 1919 created a Harlem River Commission consisting of the State Engineer and Surveyor, Superintendent of Public Works and the Dock Commissioner. They investigated and submitted a report on the whole Harlem River Improvement on the 29th day of last February. Senator Dowling introduced a bill to carry out the recommendations of the Commission, and it is gratifying to learn that recently this bill flowed successfully through the maelstrom of legislation in the Assembly.

While it contains an appropriation of only $100,000, whereas, the Harlem River Commission reported that the cost of acquiring this right of way would be $2,500,000, the effect of the bill is to establish at least, the policy of the State, and if and when the city proceeds to remove the obstructions to navigation at High Bridge, which it has been ordered by the Federal Government to begin before May 30, 1920, this will undoubtedly be accepted as a sufficient assurance by the State authorities to warrant the appropriation of the balance of the money required to secure the right of way across the Johnson Iron Works property.

In this connection, it should also be borne in mind, that the entire expense of dredging the new channel is to be carried by the Federal Government, and when completed, title to the bed of the old channel reverts to and can be disposed of by the State for an amount which will approximate the cost of acquiring the right of way for the new channel, so that in reality the State merely advances its credit and expends nothing, and the gain is enormous, both to the State as well as the Port of New York.

It will permit of the diversion of Barge Canal traffic at Spuyten Duyvil through the Harlem River to points in Brooklyn and Manhattan on the East River, as well as to the Bronx and Queens. In spite of the many obstructions which now interfere with navigation, the Harlem River took care of a traffic last year of 15,000,000 tons, of an estimated value of $1,700,000,000.

The principal obstructions to full use of the Harlem River are the sharp bend at Spuyten Duyvil near the Hudson River, and the massive piers of the stone aqueduct, which stand squarely in mid channel. The first improvement consists of the removal of the Johnson Iron Works and the cutting of a new channel through the site and the filling up of the old channel. The aqueduct problem will be solved by removing the piers from the channel and spanning the gap by a flat arch, which will be built of re-enforced concrete and faced with stone recovered from the old work.

Thus will a beautiful and historic work be preserved to the city.

These improvements will relieve congestion in the Hudson or North River, and especially around the Battery, and will remove one of the strongest arguments against the pending application for an extension of the pierhead line on the North River, as well as on the East River, the granting of which would mean an increase of millions of dollars in the city's waterfront holdings.

Senator Dowling deserves great credit for having succeeded in securing the passage of the bill introduced by him, and this credit is shared by State Engineer and Surveyor Williams, Superintendent of Public Works Walsh and Dock Commissioner Hulbert, who, as members of the Harlem River Commission, served without compensation, and, prompted by a spirit of public duty, gave their time, experience and energy to the formulation of the plan that will now be put into effect, if Governor Smith approves the bill.

Determining Carbon in Steel by Electric Resistance

A METHOD, new in principle and extremely simple, has been recently brought out by J. R. Cain and J. C. Maxwell for determining the amount of carbon in steel. It is claimed to be accurate within one-tenth of one per cent. The details were published by the authors in the September, 1919, issue of the *Journal of Industrial and Engineering Chemistry.*

The fundamental principle of the method which, it is believed, is of wide application, is the change of electrical resistance brought about in a standard solution by the precipitation into it of another substance. This substance is, in this case, carbon dioxide, obtained by direct combustion of the metal. The standard solution is barium hydroxide, of known electrical resistance. Hence the underlying chemical equation is: $Ba(OH)_2 + CO_2 = Ba CO_3 + H_2O$. The increase in the resistance is due to precipitation of barium ions. Not only is the principle new, the assembly of apparatus is also new, and offers many advantages for technical work over the methods hitherto in use for the measurement of electrolytic resistance. These require a complicated and expensive set of apparatus. Other new features are: The application of the "nomograph" for the graphical representation of resistance data, and the use of special conductivity cells, with adjustable electrodes, to facilitate the manufacture of any number of such cells without the same cell constant.

The purpose of this study was to investigate the accuracy, speed and practicability of the method. A suitable absorption vessel, with electrolytic resistance cell incorporated, is described and illustrated, as well as the method of combustion adopted. Included in the descriptive portion, are specially designed resistance-measuring apparatus, and a convenient nomographic method of applying necessary temperature corrections.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The High Cost of Publishing

FOR seventy-five years the SCIENTIFIC AMERICAN has appeared each week, despite printers' strikes, paper shortage, transportation tie-ups, and the thousand-and-one other worries that confront all publishers of periodicals. And, too, despite the constantly increasing cost of such materials and labor as enter into the manufacture of a publication, the SCIENTIFIC AMERICAN has steadfastly maintained the price of ten cents per copy. Seventy-five years! A long, long time indeed, as affairs go in the publishing world. It is a record of which we are justly proud and which we have endeavored, and shall continue, to maintain at all costs.

The past six months have witnessed the problems of the publisher multiplying by leaps and bounds. Expenses have increased at a truly alarming rate. Paper—the basic raw material of the publishing industry—has been increased in cost every thirty days, until at this writing we are paying more than three times what the same paper cost in 1914. Printing—the most essential labor entering into the manufacture of any journal—has increased twice in the past six months. Inks, lithographed covers, art work, editorial contributions, office salaries and expenses—in fact, everything that contributes toward this weekly publication has greatly increased in cost in the short space of six months.

And we must not forget to mention postage. In the good old days, not so long ago in point of time, the mailing rate for all periodicals was one cent per pound. But Congress has seen fit to change this system of mailing and has harnessed publishers with a graduated scale for various distances. Thus the United States and possessions are subdivided into mailing zones, and the publisher pays according to the distance from the mailing point to the subscriber. Whereas the rate was formerly one cent per pound, it is now, in many instances, three cents, five cents and even seven and more cents. The mailing costs, it is obvious, have risen manifold—and threaten to rise much higher.

So, all in all, the publisher is today confronted with the problem of making both ends meet, or relinquishing his periodical or periodicals. Despite every effort to maintain the price of the SCIENTIFIC AMERICAN at 10 cents as in the past three-quarter-century of its existence, the publisher has at last been compelled to increase the price per copy to 15 cents, beginning with this issue. The annual subscription price remains the same—$5.00 per year.

It is a matter of dire necessity. Other publishers have already advanced their prices, in some cases even doubling them. The SCIENTIFIC AMERICAN has reluctantly raised its per-copy price at last, but only to the extent of meeting the added costs of publishing it.

The Cult of the Superlative

JOURNALISM, so far as it is concerned with the gathering and offering to the public of the daily happenings in this world of ours, is suffering from a disease which, for want of a better name, we will call "Superlativitis." Unless memory is at fault, the grammar of our schoolboy days taught us that a distinguishing property of adjectives is that of comparison, and that of this there are the three degrees of positive, comparative and superlative.

Now for some obscure reason, your enterprising reporter, faring forth in his daily search for truth, seems to consider that his equipment is not complete unless, in addition to pad and pencil, he carries a large assortment of adjectives of the superlative kind. Of adjectives of humbler degree, or, shall we say, of less decorative quality, he includes, apparently, none whatever. He sheds them just as the private drops his blanket and other impedimenta, when going over the top for a raid.

But why this discrimination? Is it made in response to the editorial demand for "plenty of human interest" and unlimited "pep," and under the conviction that the humdrum positive and the sluggish comparative adjective are mediums of expression all too feeble for a school of journalism which, as far as the outsider can judge, seems to demand color and piquancy first, with as much substratum of fact as may serve to carry an acceptable "story"?

Several years ago a naval officer who is not unknown to the world, dropped into this office to complain that, in writing of naval matters, the daily papers seemed to think that it was their duty to proclaim that everything the navy did was superlative. "Not by that road," he said, "lies progress; what we need and what the men of the navy would like to have is constructive criticism."

On another page we publish the facts regarding General Squier's experiments in telephony through earth and water by way of a non-insulated wire. The superlativists gave an astonished world to believe that the General had promised immediate telephonic communication with Europe. Read this article and you will see that he did nothing of the kind.

Our Share of the Surrendered Fleet

IN making distribution among the Allies of what was left of the German fleet, the committee which has the matter in hand allotted to the United States as its share a battleship, a fast cruiser, and some destroyers. Just what disposition will be made of them when they get here is uncertain, although it has been stated that they will be dealt with according to the plan advocated by our representatives at the Peace Conference, that is to say, they will be taken to sea and sunk in deep water.

By far the largest and most important of these ships is the battleship "Ostfriesland," which was laid down at Wilhelmshaven in 1908 and completed in 1911, and took part in the battle of Jutland. Her particulars are as follows: length, 546 feet; beam, 93¼ feet, full load draft, 29.5 feet; and full load, 24,500 tons. Having been built, like all the German capital ships, for service only in the North Sea, her fuel capacity is small, and the accommodations for officers and men are cramped. Hence she is totally unfit for service in a fleet such as ours, which must be prepared to go to any part of the world, carry sufficient supplies, and provide comfortable berthing space for voyages of long duration.

The fast cruiser, "Frankfurt," 450 feet in length and with a beam of 45½ feet, burns coal and oil and is driven by turbine engines at a contract speed of twenty-eight knots. She has an armor belt six inches in thickness and carries a battery of eight 5.9-inch guns.

The quality of the destroyers will depend upon the date at which they were built. If they are of the latest pattern, they should be serviceable boats of high speed and well armed: but if they are of the earlier model, they are too small to serve with the powerful seagoing destroyers which constitute the bulk of our own flotillas.

What the Germans Thought of Jutland

IT has been reserved for a German naval officer to expose the absurdity of the German claim that the battle of Jutland was for them a great victory. This confession is to be found in a book which has recently been written by Commander Georg von Hase, the Chief Gunnery Officer of the battle-cruiser "Derfflinger," which was in the thick of the great battle from first to last. The reader does not proceed very far with this work before the conviction is borne in upon him that it is a straightforward and vivid account of the battle, written in a sailor-like manner by one who was an eye-witness of the dramatic events which he records.

Von Hase admits that the British "shot superbly and at a fabulous speed." "At times," he says, "so effective was the British gun fire that we stood powerless before the enemy, unable to return his fire!" The best work of the Germans was done in the earlier phases of the action, when the "Queen Mary" was sunk. To quote him again: "About 6:26 P. M., the "Queen Mary" met her doom. For two minutes our salvos had been straddling her repeatedly, and ten seconds after the last had fallen, we saw a huge red flame shoot up from her forepart. Then followed two prodigious explosions, and amidst the smoke we saw her great masses of débris rise in the air." After the loss of the two battle-cruisers "Queen Mary" and "Indomitable," he remarks: "We were fighting an enemy at the second stage of the action, inferior in numbers, but superior in fighting power, which was depressing, nerve-racking and painful. Our only means of defense was to sheer out of line as soon as the enemy found our range." In his discussion of the last phase of the battle and the retreat of the German fleet, he writes: "Admiral Scheer had realized the perilous situation of his fleet. Our van was enclosed within a semicircle of hostile ships, and we found ourselves in the soup (*im absoluten Wurstkessel*). The only means of escape was to turn the whole fleet about," that is, for each ship to execute a turn through sixteen points. "It was decided therefore to execute the maneuver unobserved and unmolested by the enemy, and this could only be done by creating a diversion." The German battle-cruisers and destroyers were ordered to cover the retreat of the main body, and as Scheer signalled the main fleet to turn about, he ordered the battle-cruiser force to charge the enemy, which was done. "Now," he says, "there broke upon the 'Derfflinger,' as leading ship, a perfect tornado of fire. . . . One 15-inch shell pierced the armor of C turret and exploded, killing seventy-three of the seventy-eight men, and setting the ship on fire at that part. Another fifteen-inch shell penetrated a roof of D turret, killing eighty men in all, instantly. With every moment, the British fire seemed to grow more intense and accurate. Another shell wrenched two armor plates from the bows of the 'Derfflinger' and tore a hole twenty feet by sixteen feet in the hull, through which the water poured whenever the vessel pitched. All her yards were shot away, the flags burned and searchlights wrecked, and all voice-pipes and telephone cables had been shot away."

Again, in speaking of the German battle-cruiser "Lutzow" he says she was "shot to pieces by the British battle-cruisers and the Fifth Battle Squadron. She is reported to have received more than sixty heavy projectiles in the course of action." Von Hase tells us that after the German fleet had retreated toward their home under the shelter of the night, they were greatly relieved when dawn broke to find that the British fleet had been eluded, and when the British did turn up next day, the Germans were too badly wrecked to be sent out.

These are only a few of the comments which the Commander makes upon the fury and destructive effect of the British gun-fire; and the fact that, in spite of this, only one German battle-cruiser was sunk, proves how excellent were the defensive arrangements, in the way of sub-division and armor, embodied by the German naval architects in their capital ships. Thus, in their battle-cruisers, not only was the belt and turret armor of battleship thickness, but there was an elaborate protection in the way of heavy deck plating against that plunging fire which sent the relatively poorly protected British cruisers to the bottom. Commander Von Hase, as we have said, was an Ordnance officer, and this fact gives particular value to his observations on the behavior of guns and armor. The terrific destruction wrought on the German ships is a tribute to the value of the heavy gun and the highly explosive armor-piercing shell of big caliber, such as the 13.5 and 15-inch projectiles with which most of the damage to the German ships was done.

Electricity

Household Appliance Data.—Data on electrically-operated home devices, now being compiled by the Industrial and Domestic Power Committee of the American Institute of Electrical Engineers, will be of great benefit to engineers and architects, as well as to all branches of the electrical industry. It will do much toward leading to standardization of electrical devices in switch control, wattage of heating elements, attachment plugs, motor designs and in many other ways aid in engineering work on electrical apparatus.

Emergency Lights.—A German firm has recently produced an automatic system of emergency lighting suitable for factories, theaters, public buildings in general, and so on. The emergency lamp is supplied by a storage battery and is connected in such a manner that it operates when the main supply current fails. A relay brings the storage battery into operation. The lamp may be switched on or off at will, but the relay resumes its operation as soon as the main supply is re-established. The storage battery is permanently supplied with a small charging current as long as the emergency lamp is switched off.

Secret Telephony—Secrecy in telephony may be attained by deforming the currents in the transmission line and reforming them at the receiver. The deformation consists in a periodic reversal of the direction of the current in a line by a revolving commutator, and the reformation takes place by a similar revolving commutator running in synchronism with the former. If the periods of reversal have a frequency of 100 cycles or over, the speech becomes increasingly unintelligible. At 400 cycles it is quite unintelligible. This system has already been described in the columns of this journal several months ago.

Electric Generating Sets in the War.—A description of the principal portable generating sets, which fed the installations of the armies in France and which by their ease of transportation and regularity of performance were of great assistance, are described in a recent issue of *Revue Generale de l'Electricite*. The author believes that these little machines have a part to play in peace time in supplying energy to work yards, in helping the work of reconstructing ruined towns while awaiting connection to networks and even, with the substitution of three-phase alternator for the direct-current dynamo, in coming to the rescue of power houses temporarily disabled through accidents.

Antennae and Coil Aerials.—An extensive research on radio transmission and reception with various types of aerials has been in progress at the Bureau of Standards, Washington, D. C. One of the most interesting questions at the present time is as to the relative advantages of the antenna, or usual type of elevated aerial, and the smaller coil aerial or "loop." This question is answered by the studies of the Bureau. As a result of this work it is possible to determine by simple calculation the distance at which a given receiving aerial will receive signals from any transmitting aerial when the current in the transmitting aerial, its dimensions, and the distance between the stations are known. The small coil aerial has many advantages, but is usually not so powerful a transmitting and receiving device as the antenna type of aerial. It may, however, have so much lower resistance than the antenna that it is equal to it in transmitting and receiving value.

Triode Tubes in the Laboratory.—Not only for signalling purposes are the vacuum tubes of ever-increasing importance, but they are also being applied to a diversity of problems in connection with electrical measurements. As an example the author of an article in *Helios* describes an alternating current potentiometer, where two currents of exactly 90 deg. phase displacement are employed to induce a voltage of any desired phase in a secondary, rotating coil. From a resistance-capacity bridge of the usual type quarter-phase voltages are carried to the grids of two triode amplifiers, each supplying one of the primary coils. Another useful innovation is the triode voltmeter. An alternating emf. is impressed upon the plate circuit of a three-electrode tube, and at a certain grid polarization the change in plate current is observed. The direct current milliameter in the plate lead thus can be calibrated so as to read alternating current volts.

Science

Christmas Island, in the Pacific Ocean, which has been a separate possession of Great Britain since 1888, is about to be annexed to the Gilbert and Ellice Islands colony. This island should not be confused with the much more important Christmas Island of the Indian Ocean, south of Java.

A Delusive Tide Motor.—The perennial project of harnessing the tides appears to have lucrative possibilities of the sort to which the Postoffice Department is required to give earnest attention. That Department recently requested the Bureau of Standards to investigate the claims made for a tide motor which was being widely advertised through the mails. An exhaustive examination proved the claims to be false, and the use of the mails for promoting the enterprise was prohibited.

The Lister Memorial Institute.—The project set on foot before the war of establishing a permanent memorial in Edinburgh to the late Lord Lister has now been actively revived. A committee has been formed to raise a fund of £250,000, with which it is proposed to erect a medical research institute, to be managed by a board comprising representatives of the University of Edinburgh, the Royal College of Physicians of of Edinburgh, and the Royal College of Surgeons of Edinburgh.

The Wagon Wheel Gap Experiment.—The unique investigation which the Weather Bureau and the Forest Service are conducting at Wagon Wheel Gap, Colo., has now been in progress for eight years. A large fund of data has been collected to establish, if possible, the relations between weather conditions and stream discharge on a forested watershed. The experiment has now reached its second stage, in which one of the two similar watersheds under observation will be denuded of its forest and the investigation will continue for a further period of years under the changed conditions.

The Highway Weather Service is one of the most popular recent undertakings of the U. S. Weather Bureau. As now developed, certain stations of the Bureau receive reports of the conditions of the roads in the surrounding region or over certain main highways and publish the same in their bulletins or in the press. The current annual report of the Bureau announces that the service was in operation last winter (1918-19) at 15 stations in 11 states, but except at four of these stations it was a winter service only and was discontinued in the spring. This service is so valuable to motorists and others that it will doubtless be extended as rapidly as the funds available for the purpose admit, but these are very limited at present.

Submarine Radio.—The last annual report of the Bureau of Standards states that members of the Bureau's staff have developed very successful methods of communicating with submerged submarines by radio-telegraphy. With a single-turn coil or loop attached to the outside of the submarine, signals can be received as well when the vessel is submerged as when it is at the surface. It is also possible to transmit from a submerged submarine a distance of 12 miles. Thus it becomes possible for a ship and a submarine to exchange recognition signals. A coil aerial is a satisfactory direction finder when submerged and readily receives signals transmitted thousands of miles, just the same as when used in the air. The Navy has equipped its larger submarines with this apparatus.

Maternal Impressions in Canaries—An interesting contribution to the voluminous literature on the subject of "maternal impressions" is made by Dr. W. F. Schrader, of Fort Wayne, Ind., in *Clinical Medicine* for December, 1919. Dr. Schrader has been breeding canaries quite extensively for eight years. Until last July no crippled or deformed chick had ever been found among his nestlings. At that time daily flights of an Army airplane over the city invariably threw the birds into a state of excitement and terror, and during this period twelve eggs were laid. Only seven of the eggs hatched, and every chick of the seven was deformed; three had no anal vents, two had extra pairs of wings, and two had twisted legs held at full length beneath the bodies. The same parent birds have since raised two broods each, and there was not a single crippled or deformed bird among them!

Industrial Efficiency

Asbestos from China.—It is estimated that an annual production of 2,500 tons of asbestos can be obtained in North China after production is stimulated by fair prices. In view of the needs of American users, it would seem well worth their while to endeavor to secure a share.

Ancient Chinese Pottery as an Industry.—An authority on Chinese procelain is responsible for the statement that it would be possible to produce such work today at the King Ta-chan potteries as in the days of Kang Hsi, although the cost would be practically prohibitive, and the coloring could not be duplicated, as the mineral coloring matter used is dug from mines in which the chemical components vary with the depth. It is said that the old molds, patterns, and designs are still in existence, and that clay such as was used for the old ware is obtainable.

French Reconstruction.—According to Eugene Schneider, a leading manufacturer of France, the French workers have refused to take up with Bolshevism, believing that it would destroy their work for their country. The French workers have shown the same steadiness and spirit that they did in the trenches. M. Schneider said that since the armistice 1,250 miles of railroad (to September 1st last) had been constructed, 600 miles of canals restored, 60,000 buildings replaced and 60,000 more placed under construction, 80,000,000 cubic yards of trenches filled and 4,000 communities restored.

Again, Leather from the Sea.—Considerable interest is at present being shown in the possibility of utilizing the skins of sharks and porpoises for the making of shoe leather. The Bureau of Standards has completed arrangements to test the comparative durability of upper leather made from shark and porpoise skins as compared with that from calfskin and cowhide. The coöperation of the National Boot and Shoe Manufacturers' Association has been secured in the making of the necessary shoes for the test. It is believed that the results of this investigation will be watched with considerable interest.

Substitute for Jute Burlap.—In connection with the investigation of a substitute for jute burlap used in sandbags for the War Department, samples of four kinds of paper, one grade of cotton fabric, and one grade of burlap have been exposed to the weather on the roof of one of the Bureau of Standards buildings and will be tested at stated intervals to determine the effect of rain and sunshine on the strength of the material. Preliminary tests are being made to determine the result of dropping a bag filled with sand or dirt under regulated conditions. The bag is dropped from definite heights in different positions in order to test the seams, the tying, and the strength of the material.

The Chinese and the Personal Contact Idea.—We are told that the Chinese merchants prefer to do business with individuals and firms with whom they are personally acquainted, rather than with distant organizations of which they know nothing more than the name. On the other hand, naturally, they are anxious to avoid as far as possible all unnecessary intermediaries. For these reasons any business is more quickly and satisfactorily developed by having some person or firm permanently located in China to act as one's representative. China is certainly the big market of today and tomorrow, and American business men will do well to give that vast country their attention.

An International Sales Building.—Press dispatches describing a proposed international sales building in Paris have given rise to so many inquiries that it seems timely to announce that the Paris Marché du Monde (Paris World's Mart) has planned this building, and that the plans call for a structure to cover 13 acres of ground, with a frontage of 850 feet, a depth of 600 feet, and a height of 6 stories. It is designed to house offices and display and sales rooms; the building is to be subdivided into some 5,000 industrial locations and 900 offices. Space is also provided in the plans for banks, shipping and transportation, credit establishments, consulates, and other services that will assist in completing sales, under one roof.

The World's Greatest Vehicular Tunnel

Some Constructional Features of the New York-New Jersey Project

By Robert G. Skerrett

STRIKES of one sort or another have emphasized New York City's physical isolation and made it imperative that the Island of Manhattan have transportational links that will permit a continual interchange of vehicular traffic between the New Jersey and the New York side of the Hudson River. Conditions of one sort or another that have heretofore impeded free communication by the existing water-borne facilities have cost in perishable property, interrupted trade, and disorganized business, many millions of dollars from year to year. Hence the urgency that now demands the promptest possible construction of vehicular tunnels.

After months of deliberation and exhaustive technical investigation, the chief engineer, representing the joint interests of the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission, reported at the close of last December the conclusions reached upon the type of structure best calculated to meet potential traffic needs for at least a decade and, at the same time, satisfy the economic and engineering requirements of such an undertaking. It is probably no exaggeration to say that no previous viaduct project within Greater New York has been given more intensive study; and every angle of the subject has been viewed dispassionately and each contributive factor analyzed without stint. The aim has been to look ahead and to avoid mistakes that would hamper a vehicular tunnel in rendering a maximum of service.

It should be no wonder to the technical world that Chief Engineer Clifford M. Holland, and his associate experts, should have decided in favor of twin cast-iron tubes and the adoption of the shield method of tunneling. This procedure has heretofore been followed in the driving of twenty-two railroad tubes under the Hudson and the East Rivers; and because of the cumulative and satisfactory experience in meeting local subaqueous conditions in the past, it has been deemed wise to pursue a similar course in joining Manhattan and New Jersey by an under-water vehicular route. Extensive exploratory borings have revealed the geological circumstances that must be met and mastered in building the tunnels well beneath the river bed and at a depth of 50 feet below mean low water at the top of the tubes. It has been decided that each tunnel shall have an external diameter of 29 feet, which is 5 feet 6 inches greater than that of the largest of the railway tubes already constructed under the Hudson River.

For sound engineering reasons, and to hold the cost down to the lowest practicable figure, while affording ample traffic accommodations, it has been considered inadvisable to exceed a diameter of 29 feet. This maximum dimension will insure enough internal space, after the placement of the concrete lining, for a double traffic roadway 20 feet wide and a clearance of 13 feet 6 inches between the floor level and the under side of the ceiling, forming the nether wall of the exhaust-air duct. Along one side of each tube there will be a two-foot walk primarily for policing purposes and for the movement of pedestrian employees having to do with the operation of the system. Beneath the floor or roadway will run the fresh-air duct of the ventilating installation.

In the shield method of tunneling, the tube lining is assembled within the protecting envelope of a circular shield which is pushed ahead of the tunnel already built and thus serves as a shelter for the men carrying on the excavating work and engaged in placing the advancing units of the tube shell. The latter in the present case will be formed of successive rings of cast iron 2 feet 6 inches wide; and each of these rings will be made up of 14 segments, approximately 6 feet long, and a key segment 1 foot long. These several elements will be bound together by 85 bolts at the circumferential joints and by 75 bolts at the horizontal joints—the several bolts having an individual diameter of 1¾ inches.

Through those sections of the route where sand and earth and some rock will be penetrated, the weight of the cast-iron lining will be 8 tons to the linear foot; but in order to increase the deadweight of the tubes in the stretches passing through silt, for the purpose of offsetting the effect of buoyancy, each shell will be of 8½ tons per running foot. Inside of the cast-iron lining there will be an inner lining of concrete, 19 inches thick, which will extend to a point 7 inches beyond the flanges of the rings. Reinforced concrete will be employed in enclosing the various ducts, in forming the foundation for the roadway, and in providing the sidewalk..

The twin-tube structure will measure between portals nearly 1¾ miles, and in diameter it will be just one foot smaller than that of the well-known Rotherhithe Tunnel under the Thames River in London, England, which was built in 1908. The vehicular tunnel, however, beneath the Hudson, presents a very different problem both in construction and in ventilation from that of the Rotherhithe tube, which was driven through a firm riverbed composed largely of clay and

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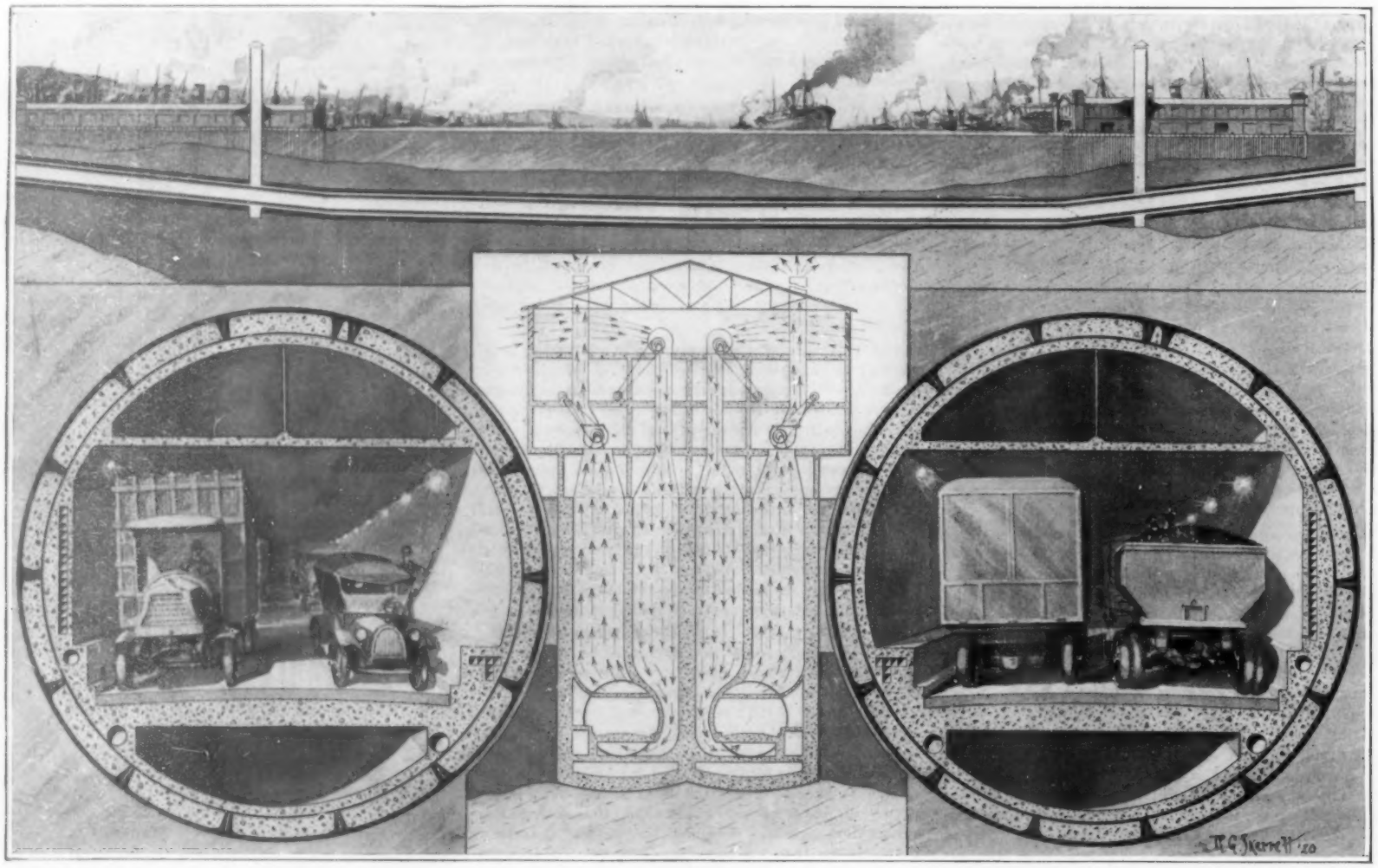
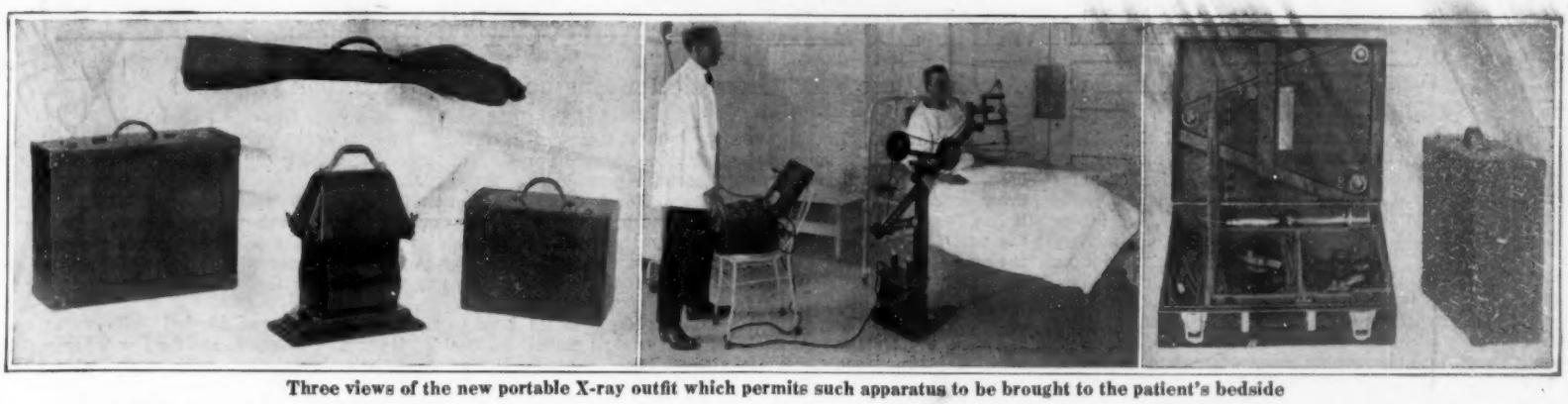


The top drawing is a longitudinal section showing one of the two tubes and three of the ventilating shafts. The tubes with one exception, where rock must be excavated for several hundred feet, pass through the mud and silt of the riverbed. The central diagram illustrates the general scheme of one of the ventilating shafts and the way in which air is supplied to and exhausted from the tunnels. The flanking drawings depict the structural arrangement of the tubes and indicate that each will provide for a fast and a slow-moving line of traffic

The twin-tube vehicular tunnel to be built under the Hudson River linking New York City with Jersey City



Three views of the new portable X-ray outfit which permits such apparatus to be brought to the patient's bedside

Bringing the X-Ray to the Patient

By Ralph Howard

FOR many years the X-ray has been the invaluable ally of surgery and medicine, but until recently it has been necessary always to transport the patient to the X-ray laboratory. Those sufferers whose condition forbade this, were, through no fault or desire of their own, deprived of the X-ray's benefits with the result that medical skill has been handicapped in diagnosing conditions which otherwise might not have been recognized. Dr. W. D. Coolidge and his associates in the Research Laboratory of the General Electric Company at Schenectady, have recently perfected a portable X-ray outfit which meets this need. The U. S. Army Portable Outfit which they devised rendered service of a high order in the European war and the new and more compacted outfit is the peace outgrowth of the army set.

It is now possible for any doctor to transport the entire new outfit, packed in four hand-borne units, to any home wired for electricity and produce radiographic results as good as those secured in a completely equipped X-ray laboratory. The process of operating the machine is simplified for him by control systems enabling him to use the exact ray intensity he needs and a time switch that accurately controls the length of each exposure. With these adjusted, the doctor merely presses a button and the machine does the rest. Plates can thus be produced which will show remarkable uniformity. An ordinary incandescent light circuit supplies all the necessary current.

The portable Coolidge X-ray outfit is made also for hospital use so that it can be taken to the bedside of patients who cannot be conveniently moved to the X-ray laboratory. The results produced with this outfit are comparable with those of an ordinary X-ray machine except its power is too low for instantaneous gastro-intestinal radiography which requires greater speed and power.

The portable Coolidge set has been greatly compacted and simplified over the army type familiar to the medical corps men.

The bulb itself has been reduced in size to 2½ inches. By making the tube of thick lead glass, thus replacing a heavy lead shield, the total weight of the tube and its protection was reduced five pounds with a consequent lightening of the frame which supports it. This lead glass made from a formula developed in the Schenectady laboratory contains about 57 per cent metallic lead and in its resistance to X-rays, is equal in protective power to lead one-sixteenth of an inch thick.

The new tube rectifies its own current, thus doing away with a heavy, bulky rectifier and adding to the efficiency of the set as a whole. The transformer has been reduced in size by the use of smaller windings and a case shaped to fit the coils. A minimum of weight and bulk is secured in all other parts of the outfit by a careful choice of materials and a study of sizes and shapes. Thus when the outfit is ready to be taken out for use, the doctor carries an ordinary size suit case containing the tube, reels, cables, base of the stand and other small parts, the transformer borne by a special carrying cover, the tube stand in a cloth container resembling a golf bag and a small instrument and control box. The whole load is such as can be put easily into the tonneau of a small automobile and as easily carried in or out of a house. The transformer, which is the heaviest unit of the four, weighs 43 pounds with its case. It is oil insulated and delivers to the tube 10 milliamperes at 60,000 volts.

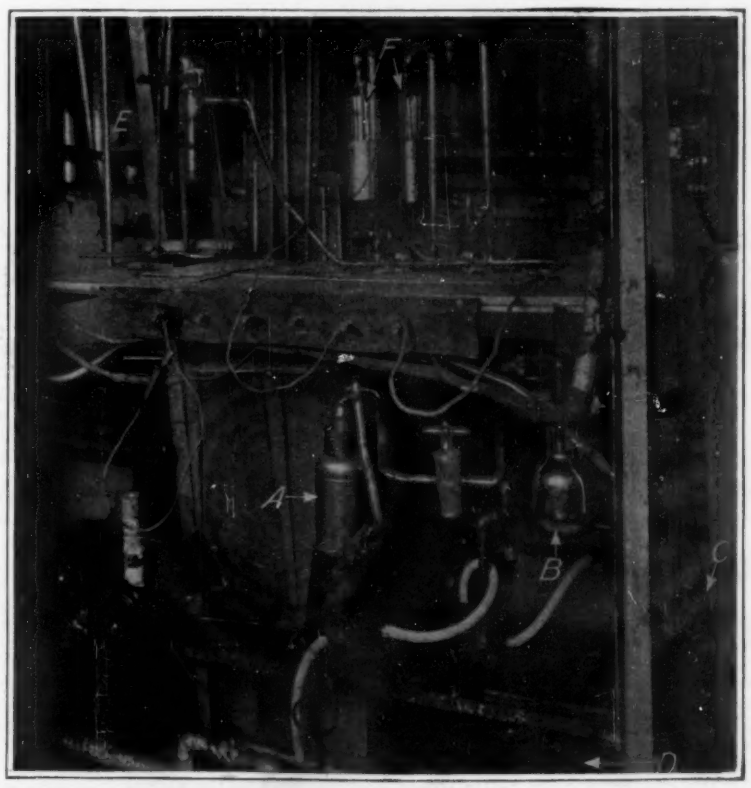
One of the obstacles to radiography in homes is the variation in circuits between city and city or even between different parts of the same city. This is overcome by the control system of the portable outfit by means of which it is possible always to deliver the same definite voltage to the transformer primary.

The operating current for the portable X-ray can be taken from a lighting circuit by plugging in the nearest lamp socket or base-board receptacle. This usually is a 110-volt circuit fused for 6 or 10 amperes making available about 660 watts or the amount used in an electric flat iron.

Thus under all ordinary conditions the new portable outfit can be used almost anywhere with the utmost ease and accuracy.

Light-Filters for Observing Pilot Balloons

THE British Meteorological Office reports that experiments on the use of light-filters for pilot-balloon observations have been made at South Farnborough and excellent results have been obtained. The use of a filter prevents the premature disappearance of the balloon image and enables the observer to keep the balloon within the field of view of the theodolite for a longer time. Consequently the range of ascents and the length of trajectories are increased.



This pump secures the most perfect vacuum known by passing a blast of mercury vapor across the mouth of the vessel to be exhausted. The lettered components are: *A*. Langmuir pump mounted over electric furnace. *B*. Liquid air trap. *C*. Trap for mercury. *D*. Rough pump into which Langmuir pump exhausts. *E*. Oven hood, shown raised. *F*. Tubes being exhausted

Details of the Langmuir condensation pump

The Langmuir Condensation Pump

By L. A. Hawkins

SCIENCE and industry have achieved many triumphant feats through the agency of vacuum, for in it there can be no loss of energy through heat conduction and matter cannot decompose by oxydizing. So the degree of achievement has been in proportion to the perfection of vacuum attained. Many machines have in the past been devised to extract as much air as possible from containers. Suction pumps are sufficient even today for exhausting such containers as electric light bulbs, but for the higher grade vacuum, such as those required for Coolidge X-ray tubes and for high power tubes for wireless use, a mechanism of much higher efficiency is required. Many types of pump have been designed to produce a specially high vacuum, but the crowning triumph in their construction was reached when Dr. Irving Langmuir devised his mercury-vapor mechanism, since come to be known as Langmuir condensation pump.

This device is not only the most rapid of all high vacuum pumps, but it also will produce the highest vacuum.

It came into being as the result of efforts to get higher and higher vacuum for the purpose of research and to get it quickly.

The perfected Langmuir pump, notwithstanding its remarkable effectiveness, is simplicity itself in its mode of operation. It has no moving mechanical parts. A stream of mercury vapor, produced by a small electric boiler, and moving at high velocity, entraps and sweeps along with it the air or gas molecules from the vessel undergoing exhaustion and delivers them to the rough pump, which ejects them into the air, while the mercury vapor itself is condensed and flows back into the little boiler.

Like most new tools of science, the Langmuir condensation pump has found a field of great practical utility. All the Coolidge tubes, which have revolutionized X-ray practice, and all the high-power radio tubes, or pliotrons as they are called, which have made long-distance wireless telephony practicable, are exhausted by this pump.

Its speed has been stated in this way—it will reduce the pressure in a 1 liter vessel (approximately 1 quart) from 100 microns (approximately $\frac{1}{10,000}$ atmosphere) to $\frac{1}{100}$ micron (approximately $\frac{1}{100,000,000}$ atmosphere) in two seconds.

But such a statement, while it tells the whole story to a physicist, does not mean much to a layman, so suppose we put it this way: Since a million is about as large a number, and a second about as short a time, as have a real meaning to the average man, how long would it take to accomplish the result above stated, if, from the vessel in question, we removed a million molecules a second? The answer is 750,000,000 years.

As for the degree of vacuum which may readily be obtained with the Langmuir pump, the physicist would say, better than a ten-thousandth of micron. This can be expressed approximately as $\frac{1}{10,000,000,000}$ atmosphere; but, even so, the statement lacks vividness, so let us try it this way. First, to get an idea of what atmospheric

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A Forward Step in Automotive Fuels

A Manufactured Fluid with Alcohol Base That Gives Better Engine Performance than Gasoline

TODAY one hears a great deal of the fuel problem, the solution of which has become the most important factor in the possible future expansion of automotive industries. The only reason for such a problematical status is our ignorance of fuels, for otherwise there would be no problem. Heretofore, and up to a very short time ago, we accepted and used that fuel for operating internal combustion engines, which was available in the most natural form. In the incipient stages of development of the automotive arts, the quantity requirements for such fuel were, of course, only small, and the supply naturally far in excess of the demand, with the standard of quality high as far as the quality of the available fuel was concerned.

It was possible then for engineers to go about their business of designing engines and operating them on the fuel at hand, with apparent success, without any special effort. The main questions of engine design were such as concerned purely physical and structural features, and there was no especial attention given to the chemistry of the fuel. The latter consideration was entirely ignored, inasmuch as there were no glaring difficulties encountered with the fuel available, on the score of engine requirements, or needs.

It was right here at the start that the engineers and everyone else concerned fell into a rut, because, by following the course outlined, the possibility of more economical performance of internal combustion engines could only progress as far as the limitations of the conventional fuel would permit. In other words, engines have been designed for the fuel, instead of the fuel being designed for the most economical internal combustion engine. But, with the internal combustion engine playing a prominent and important part in the affairs of industry and society, the expansion of the automotive industries has progressed to a gigantic magnitude, causing demands upon fuel to increase by leaps and bounds. This growth continues momentously, with each new-found application of the internal combustion engine; and unless something is done it is clearly evident that in time the tremendous demands upon the present day popular fuel will bring about an alarming situation.

To stave off this apparently inevitable fuel shortage as long as possible, the oil companies have been continuously forced to include more and more of the heavier distillates with the engine fuel, as the demands increased with the needs, bringing about the fuel conditions with which we are all becoming familiar. The necessity for changing the grade of fuel, in order to cope with this serious condition, has made the fuel less and less adaptable for the engines originally designed. Consequently, it has become incumbent upon engineers to keep pace, in engine design, with the rapidly changing quality of fuel, in order to maintain at least the original standard of performance. But this condition cannot be met in this fashion indefinitely. There is necessarily a limit and this limit is the character of the fuel. Fortunately, however, some of the most prominent engineers of the country have pointed out, in time, that we have been carrying on in the wrong direction and an immediate change in the course is required, in order to meet the situation squarely. Not only have they pointed out that we must change our course and assume a new direction, but as a result of their exhaustive studies and investigations of the problem, they have clearly demonstrated that the fuel proposition is a question of chemical makeup together with energy of combination. Evidently, therefore, if we are to design economical engines, we must correlate chemical considerations with the mechanical features involved by first solving the fuel problem.

The Chemical Problems of Internal Combustion

In order that the automotive field shall not be impaired in its progress of expansion by any failure due to fuel, the warnings of prominent scientists and fuel statisticians have been finally heeded by a host of investigators in the hope of concluding the solution of the problem by finding a satisfactory fuel. The difficulty so far met by the great majority of investigators has been in obtaining a fuel capable of meeting the large number of requirements, and above all one which is practical. In their endeavor to meet these prerequisites, a great many interesting phenomena have been brought out, from which it has been possible to draw some very important conclusions. For instance, it has been clearly demonstrated that the behavior of the fuel inside the cylinder, which ultimately affects the over-all performance of the engine, depends largely upon its chemical structure. To make the point clearer, the behavior of the fuel when operating internal combustion engines has nothing to do with its constituents; it depends entirely on the chemical makeup of the constituents. While alcohol has the same constituents as ether, still, the behavior of each when used as fuel in an internal combustion engine is entirely different. For example, it is possible to operate an engine on alcohol with extremely high compression pressures without obtaining what we have so often heard of as a "knock" or "pinking"; while, on the other hand, ether will generate a violent "knock" even under comparatively low compression pressures, and this, it has been found, is due entirely to the chemical structure. It is quite the same as in the case of taking bricks, and mortar, and building with them a pavement, a house, an oven, or other structures possible with these materials. Now, while the materials are identically the same, it is easily seen that there is a vast difference in the final structures, and the manner in which they can resist the effects of external forces.

A great deal is heard lately of benzol, and it is worth commenting upon briefly. While some very interesting results have been obtained with benzol as a fuel for internal combustion engines, it does not necessarily follow that it is a good fuel. It will be found that under full loads, benzol is apparently satisfactory, but unless you do operate at full loads there will be a copious production of carbon due to the fact that it is rich in this element. While this carbon is of an entirely different nature than in the case of the popular fuel of today, in that it is soft and flaky and easily blown out, the function of the spark plugs is nevertheless very seriously impaired. Aside from this objection there is that of not being able to operate engines with this fuel where low temperatures are encountered—benzol freezes at a temperature of 43 degrees Fahrenheit, 11 degrees above the freezing point of water.

What has been said of benzol is also true of gasoline-benzol mixtures, inasmuch as gasoline has absolutely no controlling influence over the physical or chemical characteristics of benzol mixed with it. It is possible, on the other hand, to obtain alcohol-benzol mixtures which will act satisfactorily because of the controlling influence of alcohol upon the benzol, as regards both freezing point and formation of carbon. Alcohol is undoubtedly the most stable fuel known, but in order that the best performance be obtained with alcohol alone, it is essential to operate engines at very high compression ratios. Then, again, a great deal of heat is required to vaporize a given quantity, which would make starting of engines rather difficult. But if properly blended with other constituents, all of these difficulties disappear and the important advantages forthcoming from alcohol as a fuel are realized.

The question of adopting this fuel for use in stationary internal-combustion engines has received much attention in France, Germany and England for some years on account of the potential advantages possessed by it. To begin with, its possible source of supply is limitless inasmuch as it can be extracted from any vegetable matter containing starch or sugar.

The Use of Alcohol

Besides, its greater safety due to the low inflammability of its vapor makes alcohol specially desirable when unskilled labor is engaged in using it.

In 1902, Sorel, a great French scientist, first took up serious research to determine the comparative merits of alcohol over the present-day popular fuels. He found that the advantages accruing were of very great importance; but he did not continue far enough to find a way of overcoming some of the shortcomings of alcohol. Later on, in 1906, the United States Department of Agriculture carried out an exhaustive series of tests as a means to stimulate the industry, to ascertain the difficulties encountered with, and to determine the latent possibilities of, alcohol as a fuel. While the difficulties were largely identified as a result of the above investigations, no important steps were taken to overcome them in order to derive the benefit of the advantages. One important fact, however, was established: the objection which has been held out against alcohol as regards its comparatively low thermal content is not important. While it is true that the B.t.u. content of alcohol is comparatively low, there are other advantages which a good deal more than compensate for this fuel factor; the most important of which is a greater thermal efficiency which in turn means greater energy return. After all, it is what you get out of the fuel in the end that is important, not what it started out with.

It may be desirable to indicate some of the conclusions of the Department of Agriculture on the use of alcohol. The ordinary engine can be run on alcohol without material change; the only difficulties are encountered at starting and in supplying a sufficient quantity of the fuel. When run on alcohol, operation is more noiseless than when run on other fuel. For air-cooled automobile engines, alcohol is especially suitable as a fuel. The fuel consumption is affected by the time of ignition, by the speed, and by the initial compression of the charge. The consumption is better at low than at high speeds. The average engine will give about 10 per cent more power when burning alcohol, but at the expense of a greater fuel consumption; and 20 per cent more power may be got by especially adapting the engine to the fuel. So it is evident that the advantages accruing from the use of alcohol as a fuel are most important and it is essential to provide means in order to obtain the benefit deriving from them.

The Blended Fuel with Alcohol Base

Fortunately, an important step forward has been taken by a prominent industrial company of our country, which has been investigating the possibilities of deriving the benefits inherent with alcohol and at the same time overcoming its shortcomings. It is gratifying to know that after several years of careful research a successful product has been obtained and is now in the course of commercial development so as to be properly available to the industry. It is expected that this product will take a very important part as a commercial fuel in the future.

"Alcogas," as its name indicates, is essentially an alcohol fuel synthetically blended with other constituents in such a manner as to insure absolute stability. These constituents (which are not disclosed for commercial reasons) were not chosen promiscuously, but are included therein for the main purpose of deriving the latent advantages of alcohol as a fuel, and at the same time rectifying the disadvantages which would exist if used alone. In other words, the success of alcogas as a fuel lies in the fact that all of its constituents act to assist one another in meeting the requirements, where any one of them alone could not be ex-

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SEVERAL weeks ago we carried a discussion of the gasoline situation which should have been sufficient to make it clear that we are a trifle off the right track in the automotive-fuel practice that we have been pursuing. Attention has been concentrated on the engine, and the fuel has been disregarded. We have taken the fuel which happened to be most conveniently at hand in the beginning of the automotive era, and we have bent our energies to designing an engine that would function to best advantage with this fuel. Now we find that our success has been too great—we have created an engine that functions so well on this fuel that the demand for the engine exceeds the supply of the fuel available. The remedy appears then to lie in the search for another fuel which will function adequately with either the existing engine or an engine which might be developed out of the existing one. But the fuel engineer and the automotive engineer have not been wholly blind to this increasing necessity that they work together to give us a new deal in the game of developing internal-combustion power. Indeed, very definite progress is recorded in the article presented herewith, describing the efforts of one of our leading industrial chemical companies to furnish a fuel that will be not merely a substitute for gasoline, but that will actually replace gasoline.
—THE EDITOR.

The Tools of Science

John A. Brashear—A Great Instrument-Maker and Astronomer

By Herbert T. Wade

IN these days of wonderful scientific discoveries it is of interest once in a while to consider the men who supply the tools and instruments with which such work is possible. On April 8 there died at Pittsburgh, in his 80th year, an instrument maker to whom the astronomical observatories and laboratories of precision of the world for a quarter of a century had gone for optical and other apparatus of extreme accuracy. Not merely a mechanician of extraordinary skill but also an astronomer of high rank and reputation, John A. Brashear was a product of that great American school—home study and the home shop and laboratory.

With merely a common school education and apprenticed as a patternmaker, this man whom universities were later proud to honor with degrees and other distinctions, spent twenty-one years of his life in a Pittsburgh rolling-mill, but devoted his evenings and spare hours to the study of science and the construction of telescopes. With his interest in the stars aroused at an early age Brashear as soon as he was married and well settled at his trade sought to carry out a long cherished dream of making for himself a telescope to view the heavens. With the conscientious and careful work of an American mechanic was coupled enthusiasm and interest, stimulated by constant reading in science and the sympathetic assistance of his wife. After three years of work in his simple shop this ambitious worker was able to show to the director of the Allegheny Observatory, Dr. S. P. Langley, a well finished five-inch telescope objective ready for final correction. Other work of excellence and precision done in the little home shop led to Brashear's connection with the observatory and his establishment as an instrument maker, who for delicacy and accuracy of construction soon was in a position to more than compete with the masters of the old world.

Brashear's shop, founded in 1880, soon became the source of instruments of the highest precision, and lenses, prisms, telescopes, optical surface, mirrors, gratings, and other instruments and parts, were supplied to the scientific men of the world. Here came Langley for prisms and other parts used with the bolometer, Pickering for spectroscope prisms, Hale and Deslandres for the spectroheliograph, Rowland for mirrors for his diffraction gratings, and a host of others who realized that this wonderful mechanician, no less a student of science, could realize in construction their ideas and provide the means for their research.

When it was determined to use the wave length of light in establishing the world's standard of length—the international meter—it was to Brashear that Michelson went for the optical planes and mirrors, correct to 1/20 of a wave-length of light, for the interferometer with which he worked at the International Bureau of Weights and Measures in a research now fundamental in modern metrological science. Telescopes of high grade and ever increasing size were made at the Brashear shops, and readers of the SCIENTIFIC AMERICAN will recall the great 73-inch reflecting telescope recently installed at the Dominion of Canada Observatory at Victoria, the great mirror of which was perhaps the last important large undertaking of Dr. Brashear.

This former mechanic of the steel mills also served as acting director of the Allegheny Observatory, for he could use as well as make telescopes. Where he was hospitably treated as a young workman he was able to make provision so that the general public would have the opportunity, denied to him in his early years, to see the stars through a large telescope and to attend lectures on astronomy by competent astronomers. Without instruction of a formal sort in any higher institution of learning this practical man was called to be acting chancellor of the University of Pittsburgh, and there brought his wide humanity and catholic tastes and sympathies to bear on many important problems outside of formal science as well as within its limits.

It would be difficult to find a more inspiring example for American youth than the life of this great scientist, who, unaided by university or technical school and solely by his own efforts in shop and study and by rugged character, made himself the valued friend of the world's greatest scientists, to many of whom he contributed valuable aid in their work. But not alone in pure science was Dr. Brashear distinguished. Accuracy was none the less appreciated in constructive engineering and among his fellow mechanical engineers Dr. Brashear was held in high esteem, for the days of the rolling mill and the lessons there learned to him were quite as useful preparation for many of his later problems as lens grinding in the little shop. It cannot be too strongly emphasized that in a useful life, typical of the highest American ideals, John A. Brashear made his own opportunities, his own friends, and his own reputation unaided, and of his well deserved renown American science and industry truly can be proud.

A Telephone to Europe?

What General Squier Has Done by Way of Utilizing Bare Wire Even in Water

By C. H. Claudy

THE connection between braiding machines for finishing insulated wire and an inter-continental telephone line may not at first sight be entirely clear. Yet it was the lack of sufficient braiding machinery which set the authorities of the Signal Corps to experimenting to find some method by which wire communication could be established without the use of twisted insulated wire-pairs. It is this same experimentation which, if it does not promise the establishment of an actual voice-to-ear communication between Europe and America, at least foreshadows the achievement which, when accomplished, will put all previous telephonic feats in the "easy to do" class.

During the war, what the Signal Corps calls a "key problem" was the production of braiding machines. There was enough wire and rubber and cotton, but not enough machines to turn this collection of raw resources into the forty thousand miles of wire needed per month by our forces, or the hundred thousand miles monthly that Europe would buy from us if we could make it. Had we been able to make all this wire, we would have needed 14,000 ship tons a month to carry it, in place of perhaps 2,500 ship tons to carry the same amount of bare wire, could we use bare wire and a single conductor instead of insulated wire in pairs.

In the face of these facts the Signal Corps began to think and experiment. General George O. Squier, Chief Signal Officer, told of these processes of ratiocination and experimenting before the National Academy of Sciences in session at Washington, April 27, 1920. He described the reasoning process in its simple essentials and showed that since communication between two submerged submarines was possible by wireless, the connection of the two by a copper wire could have no other or further effect than to heighten the facility of propagation of the electric waves between the submerged stations by whatever difference existed in favor of the conductability of the wire for such impulses over that of sea water. He showed that while it was noted that there was a possibility that water or earth might exhibit properties, under the action of high frequency currents, different from those with which we are familiar when direct or low frequency currents are in question, it was nevertheless understood that if a wire was buried in either water or earth and a high frequency current sent over it, no matter what losses took place, they would be less than the losses occurring in radio space transmission, where the plant efficiency, with relation to the transmitting media, is so very low. Finally, General Squier had observed and noted as far back as 1912, that the three-electrode audion could be potentially operated on open circuits, and he believed that it could thus be used for the reception of signals over earth or water buried bare wires.

With this for a starting point, two foundation experiments were tried, which General Squier described as follows:

"In the first experiment, an extremely simple one, a bare No. 18 phosphor-bronze wire, such as is used for the Signal Corps field antenna, was laid across the Washington Channel of the Potomac River from the War College to the opposite shore with sufficient slack to lay on the bottom of the river. A standard Signal Corps radio telephone and telegraph set was directly connected to each end of the wire, one set serving as a transmitter and the other as a receiver. At the receiving end the bare wire was directly connected to the grid of the receiving set and the usual ground connection left open. A frequency of about 600,000 cycles a second was used and the line tuned at each end. Excellent telegraphy and telephony were obtained. Care was taken to make this preliminary experiment as simple and basic as possible, to insure that the wire itself should be bright and clean and entirely free from any grease or other insulating material.

"In a second experiment a strip of wire netting was buried in the snow outside of the office of the Chief Signal Officer in Washington with a wire attached, leading to the second story of the building. The upper end of this wire was connected directly to the grid of an electron tube. It was necessary for maximum sensitiveness to connect it to the point of maximum potential of the antenna which in the case of a linear oscillator occurs at the open end. By this arrangement, messages were readily received from distant points in the United States."

General Squier spoke at length before the Academy of Sciences on the results of many experiments conducted by the Signal Corps Laboratory following these initial steps, after which he brought forth the idea which has caused so much comment and speculation as to the possibility of transoceanic telephony. He said: "In the older art of ocean telegraphy, the elaborateness of line construction has already reached a practical limit. The best Atlantic cable of the present day is limited in operation to electric waves of frequency of the order of magnitude of 10 per second. The electrical construction is such as to limit the voltage employed on any long cable to from 50 to 80. The relative values of the line constants in any ocean cable preclude the possibility of ocean telephony.

"The most promising hope of improving the line construction for ocean cables is believed to be to abandon the present method of design and construction, and to start with the simple case of bare wires in water using high frequency currents and study the necessary changes to produce optimum transmission.

"The use of a high frequency (carrier) has the inherent advantage that the distortion phenomena accompanying present methods of long distance transmission are eliminated, and we are principally concerned with the problem of reducing attenuation. The most suitable voltage may be employed and present multiplex methods may be utilized. The electron tube is available for both the generation and the reception of the waves.

"During the last few years an intensive study has been made of the surface conditions of wires necessary to produce the emission of electrons, and to this intensive study, both by universities and industrial research laboratories, is due the high state of efficiency of the present electron tube. Nothing short of a similar study of the surface conditions of wires for *preventing* the emission of electrons instead of producing them, will finally give us the wire conductor of the future.

"The developments of types of resonance wave coils, both open at one end and at both ends, for general radio work offer an interesting field for investigation. This involves the study of the electron tube as a potentially operated device. The application of such coils properly designed for specific purposes may lead to the practical solution of a number of radio problems, such as directional effects, and wave coil antennae of very small dimensions."

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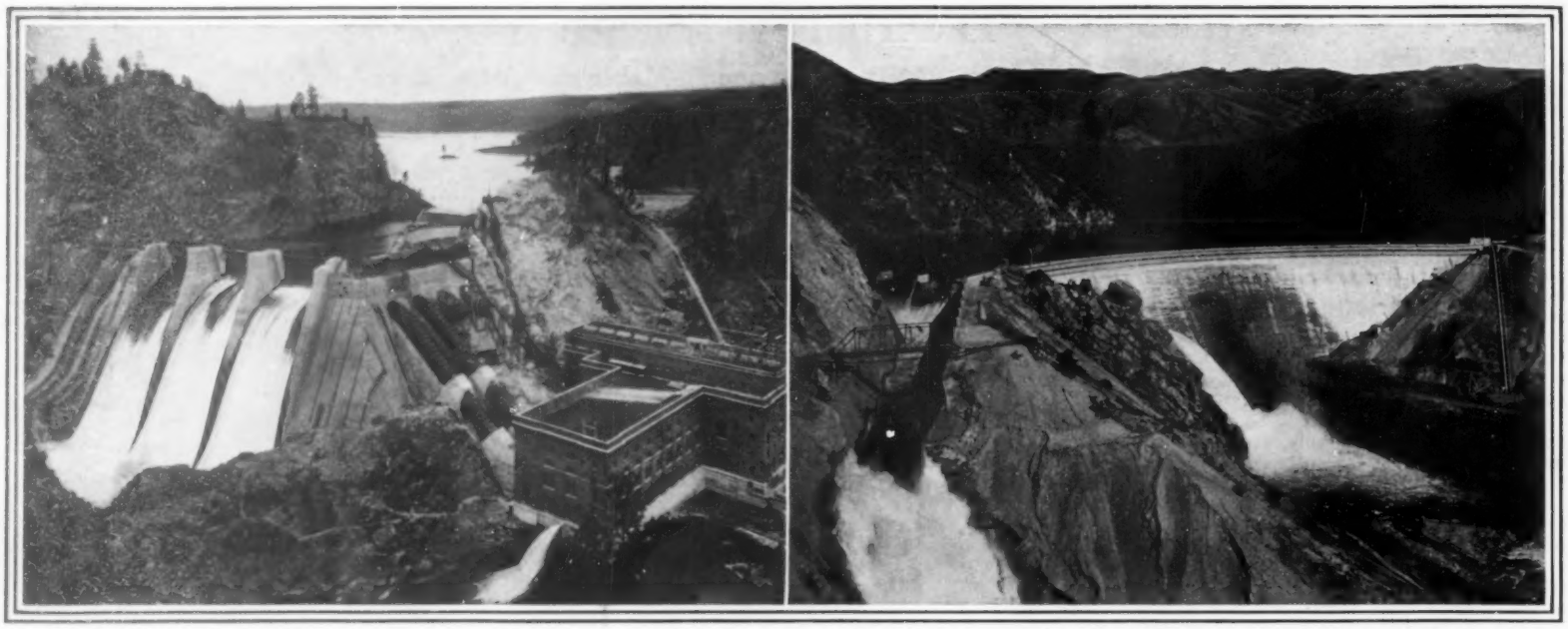


At the left: **A Western hydro-electric development capable of generating 90,000 horse-power. The spillway has an elevation of 208 feet, and the head of water feeding to the turbines is 150 feet.** *At the right:* **The famous Arrowrock Dam which impounds waters capable of producing a great volume of electrical energy**

Harnessing Our Waterpower

Why We Should Make the Most of Such Resources Within Our Boundaries

By S. G. Roberts

IF the waterpower of the United States were converted into electrical energy there would be more than enough current to turn every industrial wheel and to light every electric lamp now in service throughout the length and breadth of the land. Such, in substance, is the opinion of governmental experts. Again, these competent authorities tell us that the possibilities of hydroelectric development are in the neighborhood of quite 200,000,000 horse-power, and they assure us that fully 50,000,000 of this total could be made available without any special provisions for water storage.

Assuming that a steam-produced horse-power generated daily for only 12 hours throughout a period of twelve months requires the consumption of 5½ tons of coal, it is manifest that the substitution of 50,000,000 horse-power from water would save us annually the need of mining 275,000,000 tons of fuel; avoid the movement of nearly 7,000,000 freight cars; and release the services of quite 300,000 operatives at the collieries. The economic gains, if we made use of our falling waters, would be of tremendous moment. And yet we have in service today only 6,000,000 horse-power developed by hydroelectric plants.

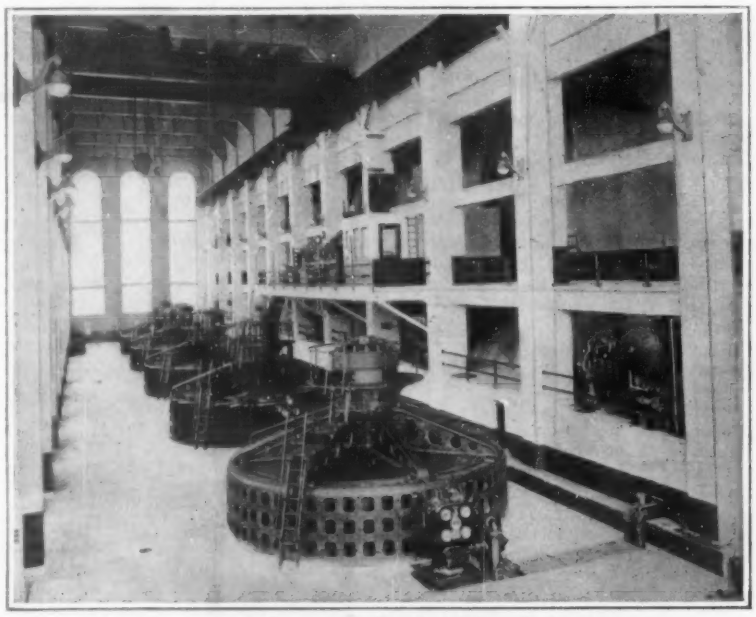
Lest the foregoing figures mislead, let it be said that a very large part of our steam-produced horse-power is required in industrial regions where nature has not made an equivalent of hydroelectric energy available. The accompanying table prepared by the United States National Museum, will make this clear, and at the same time give a notion of the natural fuel resources within reach.

While the table discloses the fact that the major share of our possible water-power resources is not contiguous to our present manufacturing centers, still the subject must be viewed from a national rather than a sectional angle; and we shall find upon analysis that this reserve of power, if effectually employed where available, would call into being vast industrial activities based upon local natural wealth of the utmost value to the entire country. Further, hydroelectric energy so utilized would hasten needful productive developments which today are dormant simply because the costly and long-distance hauling of fuel make the ventures prohibitive. Suppose we cite an instance or two to bring the force of the prospect home to us.

Natural Fuel and Power Resources Within Reach

	Potential water power (percentage of total in United States).	Unmined coal (percentage of total reserve).	Unmined oil (percentage of total reserve).
New England States..... Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut.	3 per cent	None	None
South Atlantic States..... Delaware, Maryland, Virginia, South Carolina, Georgia, Florida.	6 per cent	1 per cent (practically all in Virginia and Maryland.)	None
Southwestern States..... Arizona, New Mexico, Texas, Oklahoma, Arkansas, Louisiana.	6 per cent	4 per cent (mostly in Oklahoma and Texas.)	52 per cent (includes Kansas).
Pacific States..... California, Oregon, Washington.	43 per cent	2 per cent (mostly in Washington).	31 per cent
All other States.....	42 per cent	93 per cent	17 per cent

(Figures approximate and given in round numbers.)



The operating floor of a great hydro-electric installation presents a strikingly neat appearance

During the critical period of our participation in the World War we needed manganese for steel making—manganese that hitherto had reached us by ships from Brazil. Out in Montana, 2,000 miles away, a certain waterpower development made it practicable to employ a process for the treatment of low-grade manganese ores, and thus steel mills in Pittsburgh were able to get the alloy essential in producing metal for munitions, etc. The same power enabled us also to obtain a great tonnage of indispensable copper at a time when our enemy was desperately hard put to it because of a lack of this metal. Again, in six of our Western States there are stands of pulpwood timber capable of producing quite 160,000,000,000 feet, board measure, of raw material for the manufacture of paper, and in the same States there is a total of 36,000,000 water horse-power that can be made available for dealing with the timber and other natural riches. In view of the present paper situation, the future of the publishing business in the United States hinges to a considerable degree upon what we do towards utilizing our domestic resources instead of becoming more and more dependent upon other countries which will be able to charge us just what they please in the years to come.

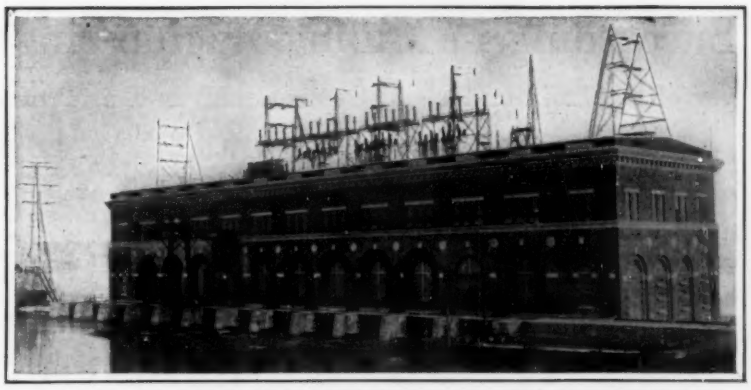
It should be a source of much satisfaction to us that there are planned hydroelectric developments totalling 2,122,000 horse-power which will be taken in hand upon navigable streams as soon as a rational Federal waterpower act is passed by Congress. Further, subject to the same condition, the intention is to erect other plants capable of generating more than 2,000,000 horse-power on non-navigable streams, the waters of 25 widely distributed States being involved. By the damming of the 35 rivers in question, the present water levels will be so raised as to extend navigation for a combined distance of 4,000 miles, thus opening water routes and cheap transportation to dis-

tricts now sparsely settled or promising relief to congested land lines tributary to very populous sections. And these benefits would be accomplished through the agency of private capital rather than by the usual process of appropriated public funds.

From the very nature of hydroelectric undertakings, disproportionately heavy initial outlays are required to cover the cost of riparian rights, dams, flumes, impounding reservoirs, etc. Further, the plant capacity will seldom find a market until after a period of years, and the major part of the expense cannot be apportioned agreeably to the gradual growth of a profitable demand for current. Finally, when the day of maximum output is reached and a market for more power becomes available, augmented equipment must be provided to take care of not only the immediate customers but of those that may come later on. For both engineering and economic reasons, hydroelectric developments cannot be carried out gradually and as closely in accord with contemporaneous requirements as is possible with steam-driven central stations. It is for this reason that the arbitrary limiting of operative rights to a prescribed term of years is apt to prove a deterrent to private enterprises of this sort. And it is just this thing that Congress proposes to do where waterpower sites on public lands are involved.

While a 50-year period may be long enough for a hydroelectric company to amortize its capital investment and to pay an inviting interest upon that outlay, this result will depend very much indeed upon the location, the physical conditions to be met, and the quickness with which the concern may be able to dispose steadily of approximately a maximum output of current. Nature hasn't put so many of her potentially valuable waterpower sites near our industrial centers or thickly-built-up regions. And to a considerable extent the backers of hydroelectric developments will have to be patient and count upon their enterprise to draw within their operative zone, as time goes on, people who will want that energy. It may not be a matter of common knowledge, but out of our possible 50,000,000 water horse-power yet to be developed, about 80 per cent of it is located inside of 13 of our Western States where the Federal Government retains proprietorship over more than two-thirds of the aggregate acreage. In short, just where the falling waters are especially adapted to power utilization. And here it is that the 50-year restriction would apply perhaps detrimentally if Congress should see fit to limit operative enjoyment to that term.

The World War brought home to us, and likewise to the peoples of Europe, how essential it is to become less dependent upon fuel as a source of motive energy, etc., and Great Britain, France, Sweden, Switzerland, Spain, and Italy are all of them concentrating in a very suggestive manner upon hydroelectric power developments. One French corporation, with a capital of $50,000,000, is bent upon developing the waterpower of the Rhone, and, at the same time, upon improving the means of water transportation. Again, the French are determined to make the most of something like 4,700,000 horse-power available in the Vosges, the Jura, and the Pyrenees Mountains; and already the Midi Railway System is in course of electrification.



A hydroelectric plant in Alabama, which develops a total of nearly 113,000 horse-power with only six men in attendance at a shift

The hydroelectric projects abroad bear more or less directly upon our own problem in the same field, because there is every likelihood that American builders of electrical machinery and manufacturers of water turbines will have much if not most of their productive capacities engaged ere long in turning out equipment for the foreign undertakings. In fact, several of our engineering concerns have reported that the number of Enropean inquiries for waterpower machinery is three time as numerous as those originating from possible purchasers here in the United States. And one well-known manufacturing company has not hesitated to say that it is strongly convinced that we are going to lose ground if we permit foreign nations to surpass us in the development of waterpower, because they will thus enjoy an advantage in competition for world trade. The reason for this assumption is based upon a Parliamentary Report made by a Commission of experts in 1917, which declared that the United States was notably superior industrially owing to the fact that our workmen had behind them 50 per cent more power than their British fellows.

Today, it is feasible to distribute electrical energy for distances up to 250 miles from the source of generation, making it possible to transmit current throughout a zone of more than 196,000 square miles. Up in Canada, current produced at Niagara Falls is being sold in the city of Windsor, 250 miles away, at a price but half that charged by an American company to its

(Continued on page 530)

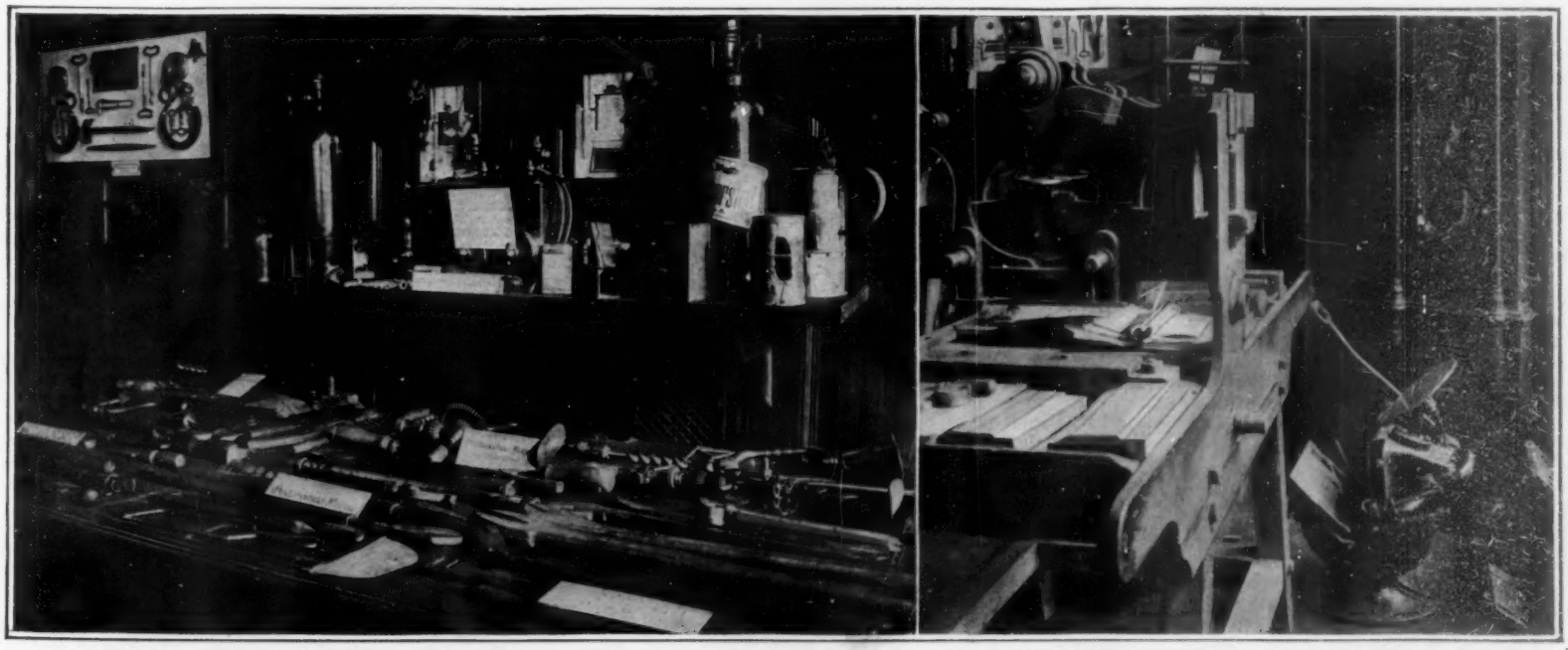
A Trip Through the Berlin Criminal Museum

THE Berlin Criminal Museum, located in the Police Headquarters building at Alexanderplatz, owes its present condition with its large collection of valuable material to the efforts of the former Director of the Berlin Detective Force, Councillor Hoppe. This museum is very seldom visited by a "non-official" person; the fortunate one, who has been permitted to view the museum, has surely been previously investigated and full information has been obtained regarding his personality, etc. It is not that the Administrator of the Museum is discourteous or is unwilling to accommodate in showing his treasures. The visitors of the museum are closely scrutinized, because it is known that the museum contains material from which weak characters may draw lessons that for their fellow-creatures may be anything but pleasant; and the police department naturally does not wish to put itself in the position of giving instruction in the technique of crime.

The museum pretends to be nothing else but a collection of instructive material for the detectives, a school supplied with all the material needed for its special purpose. It therefore contains principally the tools of the criminal world in all its forms, such as implements for murder, printing presses by which counterfeit money is made and, in a special department, seized masochistic and sadistic instruments of torture. The many tools of thieves contained in the museum have been taken from apprehended criminals. From the primitive, common skeleton-key to the highly developed artistic instrument of this type with movable bit, all possible styles of the illegal means are to be found that help the criminals to "reach the source of wealth." Small, miniature keys, works of the greatest precision, hang next to heavy chisels, destined to do the coarser work. Nippers and levers, with which the thieving gentry is supplied, are found there in large variety. Perhaps the most scientific exhibit is that of the tools and supplies of the forging and document-altering profession.

A special object of the museum is the safe exhibited for purposes of study. It was at one time opened by safe-breakers and serves now as an example as "how it should be done."

Practically the entire collection of instruments of the museum, taken from the apprehended criminals, represents the home industry of the criminals. We can see that this class contains artists as well as bunglers. The most inventive and smartest are possibly the poachers. They dress their rifles and slings in the strangest forms. The elegant walking cane has killed many a deer. It is a finely lacquered rifle barrel; its butt can be carried in the pocket and only need be screwed on to complete a gun.



Left: Tools for opening safes and entering dwellings, stores, etc.—files, saws, jimmies, bull's-eye lanterns, drills, bits, acetylene torches, and similar apparatus. *Right:* Printing presses used by counterfeiters and a safe that has been opened with the acetylene torch

Interesting exhibits from the Berlin Criminal Museum, where the German police officers learn the tricks of the men whom they must circumvent

Succeeding in Mining Engineering

A Survey of the Training for and Opportunities in This Profession

By Raymond Francis Yates

WHEN the writer came to consider mining engineering as a topic for discussion in this series of articles, he realized that he was about to treat of the most important of engineering sciences. Fully conscious of the meaning of the profession to the welfare of our country, and understanding the need of strong, virile men to follow its rugged but remunerative course, the writer decided to use great care in choosing a man to interview who could give him the proper inspiration, understanding and knowledge of the field, so that the young men reading the article could feel the grip and sense the fascination of this, the grandest of engineering fields.

John Hays Hammond, Sr., kindly consented to give his views and the advice contained in the following lines comes from the world's greatest mining engineer. John Hays Hammond, Sr., earned his success through hard work and years of faithful service in developing mining projects and in bringing to the surface of the earth those mineral deposits which are so vital to the progress of our civilization.

The value of the services of a mining engineer to his country are second to none. The wealth of a nation lies largely beneath the surface in the form of mineral deposits and it is through the skill of the mining engineer that these minerals are brought forth and made available for the use of industry. If, during the war, the supply of any one of the common metals had been cut off, this country would have been almost helpless. Iron, coal, lead, copper, zinc, nickel, silver, gold, etc., all of these important substances must be mined from the earth. Due to America's vast mineral deposits, it has always been the land of opportunity for the mining engineer and our great wealth and prosperity have come through bringing these valuable substances to the surface and using them. The most essential factor in the development of a nation is a domestic source of minerals.

When Mr. Hammond was asked what education he considered necessary for success in the field of mining engineering he answered that any of the good mining engineering schools provide the requisite preliminary training necessary for success and he added with emphasis that this was only true *as far as education itself went as a factor*. Much depends upon the individual. He also remarked that a commercial course should be included in the curriculum of a mining engineering course as a knowledge of business methods is indispensable to the large achievement of the engineer. This is more true of mining engineering than probably any other profession and part of Mr. Hammond's great success can be attributed to his keen business sense. His is a rare combination of business and engineering talent. But one must not fail to understand that Mr. Hammond is first an engineer, then a business man. Another important point for consideration is that the education of a mining engineer does not end when he receives his diploma. In fact it must continue for several years after this in actual service before a man is able to qualify for a real position and take his place among the seasoned engineers of the profession. The young man leaving college must enter the mine, work in it, know it, and rub elbows with men who have done things in the field before he is able to face the problems offered by a new development or project.

"Is it necessary to go to college to become a successful mining engineer?" some young men may ask. Mr. Hammond has answered this question and what he said rings with truth and wisdom. Very few of the more prominent engineers of today have not had the advantage of a thorough technical training. There is always the fellow of exceptional ability who wins through by sheer pluck and courage. Such a man must be inspired by intense love for the field and a great desire to conquer because he earnestly believes that it is his life's work. For this man success lies at the end of a long road of hard, conscientious work. Of course, there is only one thing for the man to do who wishes to educate himself out of college, and that is to start at the mine. Working in the mines alone will not bring success. Diligent study must also be entered into. Mr. Hammond has had a few men on his staff who were not educated in college but he reminded the writer that they were *educated* and not "rule-of-thumb" engineers. Any young man who feels that this is his life's work should not hesitate to enter the field if he cannot attend college to obtain the proper training. Before doing this, however, he should take the "temperature" of his enthusiasm and convince himself that he is entering the field for the love of the work and that nothing else would hold the proper interest for him. If he makes his ambitions known at the mine where he is employed he may be able to gain the confidence of one of the engineers who will give him advice and counsel.

It is quite impossible to state the average pay of a mining engineer, or to state the limit of salary for those who reach the uppermost heights of the profession. Some engineers who have worked for Mr. Hammond have received $50,000 per year and upward. They also received the opportunity of participating in the profits of the enterprise with which they were connected. To enjoy this advantage a man must manifest a keen interest in his work and feel that his employers' interests are really his own. For the well-trained man there is always room at the top and the engineer who thoroughly understands the technical requirements and has vision, courage and business acumen can obtain very much larger salaries and financial compensations of other kinds in mining than in any other engineering profession. Young men reading this article should not permit this high salary to lure them into the field, however.

THERE exists an impression that the engineering professions are not adequately remunerative. One reason for this, we fear, is found in the experience of a considerable body of men who insist on entering these professions, lacking either sufficient preparation or the proper temperament and ability, or in many cases both. No one should make the mistake of underestimating the demand which engineering work makes upon the individual. To an intelligent outsider it would seem sufficiently obvious that before a man can design a building to perform certain functions and carry certain loads and meet certain requirements in other directions, he must receive an adequate training in the mathematical and physical sciences. Yet no one but the Dean of a School of Architecture would believe how many men flunk hopelessly out of such a school each year because of this requirement. An artistic temperament has led them to suppose that they wanted a career in architecture—only to be encountered with the paralyzing information that they must acquire a working knowledge of analytical geometry and calculus. And to some degree the same surprise awaits many who seek technical careers in any line—in that of mining engineering, for example. There is something appealing to the poetic soul in the idea of wresting her concealed stores of mineral from Nature's grasp; but Mr. Yates points out what preliminary work is essential before the would-be engineer can hope to do this successfully. The rewards, however, are there for the man who can qualify; and of this aspect too Mr. Yates speaks.—THE EDITOR.

The profession of mining engineering cannot be said to be an overcrowded field although there is no actual shortage of men. There is still plenty of need for men of exceptional ability. The mining engineer of average or ordinary ability, just like the man of ordinary ability in any other engineering profession, will find considerable competition in the coming years. This is quite true in most of the engineering professions.

When Mr. Hammond was asked what qualifications a man should have before entering the mining engineering field he remarked, "I do not believe that a young fellow should make a career of mining engineering unless he is sure that he loves the life of a mining engineer. He should realize the hardships and privations to which he will be subjected, if he wishes to attain unusual success. The very best opportunities will be found in what are today the inaccessible portions of the world in opening up new fields. It is not a profession for 'mollycoddles.' To be a real successful engineer one must have some of the spirit of romance and adventure. It is a calling of big, strong men capable of suffering hardships and content to forego the pleasures and conveniences of our modern daily life while working in remote corners of the world. The mining engineer may be called upon to go into the stinging cold of Alaska or the stifling heat of the torrid zone. Mines are made where Nature laid away her deposits. The young man desiring to be a mining engineer should have vision and yet be conservative. He should be level-headed, energetic, persevering, courageous, not afraid of hardships, should be resourceful and indeed possess nearly all of the qualities essential to success in other lines of achievement. Needless to say he should be a fellow of unimpeached integrity and honesty of purpose."

To obtain a thorough training in the rudiments of mining engineering at least four years of study is necessary and this supplemented with at least two or three years served in subordinate positions to gain the essentials of practical experience.

There are not many specialized branches in mining engineering, but just at present there is a large demand for economic geologists who have specialized in petroleum projects. Of course, the mining of each mineral has its own special problems and a man may become more experienced in the mining of one mineral than another, but there is no great advantage in doing this. The college course in engineering does not need to carry the student a great distance into the study of mathematics as mathematics is of lesser importance in this profession than in mechanical, civil or electrical engineering.

There does not seem to be a great opportunity for a mining engineer to set himself up in an independent business. Most of the prominent engineers are connected with large mining corporations. However, there are a few independent consulting engineers who have incomes entirely commensurate with their ability, training and experience. Mr. Hammond thinks that it should be the ambition of an engineer eventually to become himself an investor in mining enterprises, to derive in that way larger financial consideration than he would as a mere employee of capitalists. The salary of an engineer of large ability is sufficient to give him a considerable interest in any project if the larger part of his earnings are invested for ten years or more. This is especially true of the man with an earning capacity over $15,000 yearly. If the engineer is located in some remote corner of the globe living expenses will come very low and the greater portion of his earnings can be invested in the enterprise with which he is connected. This will in time give him more faith in what he is doing and he is also in a position to know the possibilities of the enterprise with which he is connected.

When Mr. Hammond was asked if he believed that the curricula of our best schools teaching the profession of mining engineering could be improved upon he replied that while he thought the training they gave was excellent, he believed that there was considerable room for improvement especially in the way of additions.

And what as to the ambitions of a mining engineer? This is indeed an important question to be considered in this article. Every professional man has an ambition of some sort. If he has not his profession does not mean much to him and he will attain only mediocre success. It is the man with a desire to fulfill, with something that he has placed before himself to attain, who is really successful in his work. The writer once talked with an architect who had an ambition to design a perfect tenement dwelling for the poor and he had decided to spend a large part of his career in this humane work. No one can deny that the realization of his ambition would mean a great service to his country. Mr. Hammond's ideas of the ambitions of a mining engineer follow:

"He should leave a record of constructive achievement in the development of great mining industries especially in sections worthless save as to the development of their mineral resources.

"Every engineer should be ambitious to elevate his profession to the very highest standards of appreciation of the people of the country. There is no profession that has a finer body of men, of higher character, honesty, integrity and ability. All engineers are de-

(*Continued on page 531*)

A New Microphone Hummer for Electrical Tests

THE early experiments in a new art are usually conducted with the materials at hand. As the art advances further improvements are made by the use of better materials. Electrical engineering in its many phases is a striking example of this method of development. No longer is a cable merely an insulated wire or group of wires. The greatest care is now taken in the selection of materials used in the cable. To prevent heating of the cable, the insulating material must have low dielectric losses, and these losses should not increase rapidly with temperature. The electrical research laboratories are continually at work studying such problems as these.

Many electrical measurements, particularly those of inductance and capacitance, require a source of alternating current which has a pure wave form. The presence in the supply source of harmonics, of even very small magnitudes, may introduce serious errors in the results. For furnishing such a source of alternating current there has recently been developed a microphone hummer, or audio oscillator as it is known commercially, which is simple in its operation, rugged and reliable.

The circuits of this hummer are shown in the diagram. As the instrument is self-starting and requires no attention when running it may be located at any convenient place in a laboratory and leads brought to the point where the current is desired. The hummer operates on from four to eight volts. The output voltages range from 0.5 to 5 with corresponding currents from 120 to 12 milli-amperes. The tuning fork is carefully adjusted and maintains a constant frequency of 1,000 cycles. The resonance circuit, consisting of the secondary of the input transformer, the primary of the output transformer, the armature coil, and the condenser, is adjusted to the frequency of the tuning fork. The use of two transformers prevents the output wave from containing any direct current component. Each transformer core has a small air gap to prevent distortion of the wave form.

Success or failure in the operation of a hummer lies largely in the microphone button. If the button heats so that the oscillator cannot be run indefinitely, if the adjustment of the button is not permanent, or if slight mechanical shocks change its operating characteristics, the oscillator has little commercial value. A distortion of as small an amount as one five-hundredth of an inch from normal will destroy the perfect operation of the button. In order that the button may be insensitive to mechanical shocks and yet operate properly at its normal frequency of 1,000 cycles, use is made of its high inertia effect at the latter frequency. One side of the button is attached to the tuning fork by means of a short flat spring. The other side, which has a projecting mounting post, is held in position

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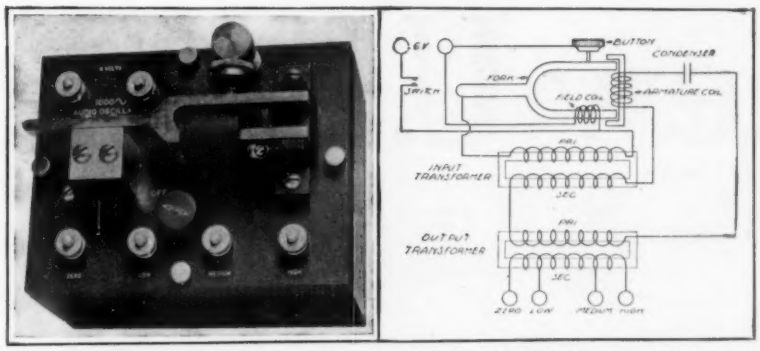
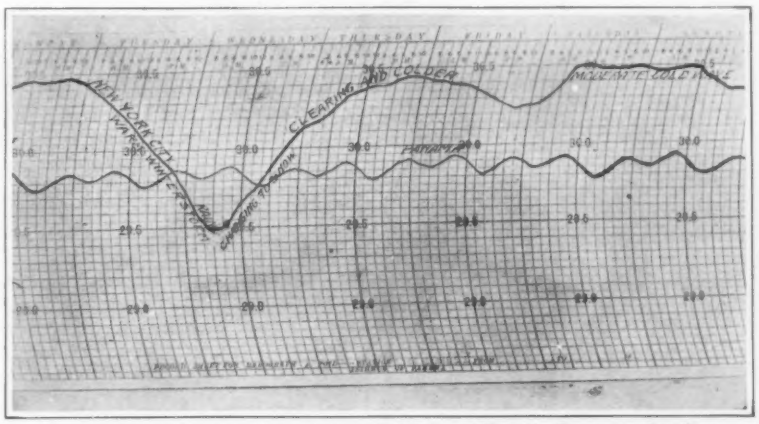


The "hummer" —an electrical device that emits musical high-frequency current for testing purposes



Barometer readings for New York and the Canal Zone in Panama, showing their relative fluctuation

Weather Predictions from Local Barometer Readings

THE accompanying diagram shows why it is that local barometer readings in the tropics are of much less value in indicating approaching weather conditions than are barometer readings in the stormier temperate zones.

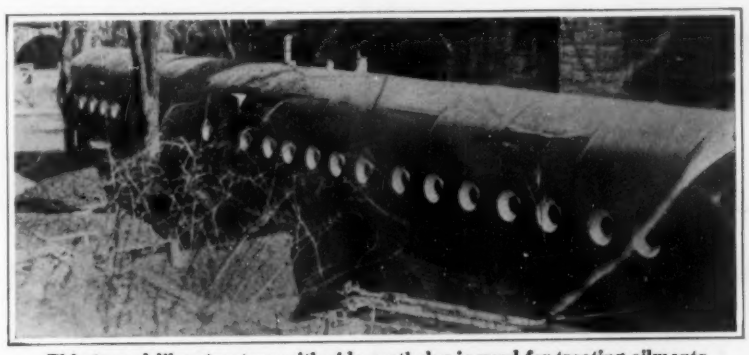
In the tropics the barometric pressure is very constant and uniform, except for well marked diurnal fluctuations due to day and night changes in air temperature; while in the temperate zone the pressure fluctuations are very large, due to the frequent occurrence of extensive cyclonic and anti-cyclonic storms.

From the diagram it will be seen that the regular pressure curve of the tropics gives no hint of future weather conditions, while temperate zone pressure fluctuations are very significant. It would not take much of a weather prophet, inspecting the New York City curve, to predict the approaching warm winter rainstorm followed by snow and clearing and colder weather.

Fortunately but few severe general storms occur in the tropics, the only notable exceptions being the hurricanes of the West Indies and the East Indian typhoons, but these storms are confined to a relatively limited area and they are preceded or accompanied by important pressure changes that warn experienced navigators of approaching storm conditions.

In the temperate zone changes in pressure usually foretell a change in the weather, low pressures bringing stormy weather and high pressures bringing fair and cooler weather.

In the tropics the cart is often placed before the horse, prevailing weather conditions *causing a change in pressure* instead of the pressure fluctuations bringing about a *change in the weather*. A period of clear weather will cause a drop in pressure, because of the increased solar radiation reaching the earth's surface, heating and expanding the air; while a cloudy period will cause a rise in pressure by protecting the earth and lower air from the heating effects of direct solar radiation.



This tunnel-like structure with side portholes is used for treating ailments by compressed air

Can Ailments Be Cured with Compressed Air?

IN the exclusive residential district of Kansas City, Mo., there has been built a long steel tunnel-like chamber for the treatment of certain ailments by compressed air. The structure is the design of Dr. O. G. Cunningham of that city, and measures 88 feet in length by 10 feet in diameter.

The steel chamber is located outdoors, as shown in the accompanying view. The interior is fitted with sleeping equipment very much after the fashion of a sleeping coach, and accommodates 72 patients. It is reported that many local business men, as well as persons from all parts of the country, are taking the cure.

The length of the treatment, so we are told, varies from 3 to 12 hours daily. A pressure of from 5 to 20 pounds per square inch, depending on the condition of the patient, is applied. It is claimed that the immediate effect of the treatment is an enormous stimulation of energy, a quieting of the nerves, an increase of appetite, and, withal, restful sleep. However, without actual experience with this compressed air cure we are not prepared to pass on its merits; suffice it to say, however, that the structure illustrated, with its portholes and other features, is quite novel.

This silent guide, installed in London's subway, points out the way to any desired destination by means of its electrified map

The Silent Guide to London

ALMOST ingenious application of electricity has recently made its appearance in the form of the silent guide using the subways of London. This automatic guide, which is shown in the accompanying view, instantly directs a person how to get to a given place, when said person presses a button bearing the label of the destination.

The device, it will be noted, consists of a large transparent map behind which are numerous electric lights. On three sides of this map are columns of names and corresponding push buttons, properly subdivided into places of interest, theaters, hospitals, railroad terminals, and so on. A person wishing to be guided merely presses the button labeled with the destination, and instantly the route is illuminated on the map. A square red light indicates where the person is, a green light indicates where to change trains or cars, a round red light indicates where to alight, and a white light gives the ultimate destination.

Rubber solid truck tire

To this great contribution to motor economy and efficiency the United States Rubber Company added another.

It *overcame base separation* by effecting a chemical union between the steel and the rubber—the *first* time such a thing had ever been done.

Just as the first time any radical change was ever made in passenger car tire designing was when the United States Rubber Company introduced the straight side automobile tire.

It is not enough to create better tires. They must be accompanied by *better truck tire service.*

U. S. Solid Truck Tire dealers are *selected* for what they *know* about tires—how well they are able to *serve the user*—and not for any particular cleverness in sales talk.

Find one, put your truck tire problem in his hands, get his advice about the type of tire best able to meet your own trucking conditions.

As a representative of the oldest and largest rubber organization in the world, he is in constant touch with the latest tire developments.

Specify U. S. Grainless Rubber Solid Truck Tires when ordering your new truck.

United States Tires

United States Rubber Company

Fifty-three Factories — *The oldest and largest Rubber Organization in the World* — *Two hundred and thirty-five branches*

Watering Idaho's Desert

A Hundred-Million-Dollar Project Involving Two and One-Half Million Acres

By J. F. Springer

1. Irrigation on south side of Snake River, near the new town of Heyburn. This view is looking towards Albion Mountains, and shows Mt. Harrison and Mt. Independent. 2. Stacking alfalfa on irrigated farm. 3. The Teton range and Jackson Lake.

Some features of the Minidoka Project, Idaho

PROBABLY only a small percentage of our 110,000,000 people have any substantial knowledge of the Snake River. But more and more people are going to hear of it as the years roll on. This stream is to furnish the bulk of the water for one of the greatest of all reclamation projects. At present, about 175,000,000,000 cubic feet of water flows over the crest of Milner Dam every year and is lost in so far as the irrigation of desert and other lands contiguous to it is concerned. This is a mighty loss to be endured in a region where water is so necessary and so precious. It is the desert region in the south of Idaho that will be especially benefited by the realization of this project, upon which it is proposed that the total expenditure shall be some $100,000,000. When the Snake has been made to do its full duty and other sources of water supply put to proper tribute, a million acres of desert will be reclaimed and 1,500,000 other acres will be guaranteed an adequacy of supply.

Idaho has the desert and also the water; but the two are not in proper relation to each other to yield maximum service to the wants of men. But this proper relation may be artificially created, and this is exactly what the great Snake River project proposes to do. It is claimed that this enterprise falls into a class by itself, outranking all other irrigation projects, not excepting the monster achievements of the British in Egypt and India.

The Snake River belongs to the Pacific drainage slope; but one feature of the great scheme involves the tapping of the water supply of the Atlantic and bringing it into service on the western slope by means of tunnels through the Continental Divide. A big dam a mile long forms part of the undertaking. This will hold in storage an amount of water equal to about three-fourths of the great total now lost.

While the cost will be great—say $100 to $125 per acre of desert land reclaimed—the reward of success will, it is thought, be ample to justify it. There are already in the drainage area of this same Snake River sections of land which were desert not so long ago but which are now among the bountiful districts of the world. Thus the Minidoka and Twin Falls developments, containing a total of 448,000 acres of land under irrigation, produced in 1918 a crop valued at $89 per acre. At Minidoka, there is right now a development which includes a hydroelectric station. Here, 100,000 acres have been reclaimed from desert conditions. The land is pretty fertile, as may be judged from the fact that it produces crops having a value of $60 per acre. Farther down the Snake River Valley are 500,000 acres of reclaimed land. Some of the best of this region has been changing hands at from $350 to $500 per acre. And, it is said, the demand is greater than the supply. These are not future visions, but present realities. The soil is naturally splendid, except for the one thing—moisture. This lack, Nature has provided for in the water of the Snake River and of other sources of supply. All that men now need to do is to gather, hold and at proper times distribute Nature's gift. One of the big districts which will become part of the great scheme is a desert region in the Snake Valley between Shoshone Falls and Mountain Home. Here are some 500,000 acres of primitive desert, waiting only for a regular and adequate distribution of water to convert it into arable land.

Sugar beet field near Burley, Idaho, showing the heavy yield

For money, naturally, the great reliance is Government. But money can, to some considerable extent, be found elsewhere. Rights in the reservoirs are salable. Already requests total some five or six million dollars. Part of the land, it is understood, is held by private owners. These may be expected to come forward and help in the financing.

The Snake River rises in the State of Wyoming to the east. There are two forks. The more southern takes its rise in the south central portion of the Yellowstone National Park. The Continental Divide passes close by. Just south of the park is a considerable body of water known as Jackson Lake. To its east is a small sheet whose name is Two Ocean Lake. This is a notable geographical feature located so exactly on the Continental Divide that it depends upon the height of the water in the lake to which slope—the Atlantic or Pacific—the outflow will go. With this fact in mind, one will not wonder at the name. This Two Ocean Lake is, along with Jackson Lake, connected up with the south fork of the Snake. The north fork takes its rise in Idaho to the west of the Yellowstone National Park. The south fork is, perhaps, the more interesting of the two. It passes between Grand Teton, on the west, and Mt. Leidy on the east, tending south all the time. Finally, when about to leave Wyoming, it swings round the southern end of the Snake River range of mountains, passing through a grand canyon. Arrived in Idaho, it finds its way between the Palisades and the Caribou Range. It then enters and passes through Lower Canyon. The junction of the two forks is sufficiently complicated to result in the creation of a big island, having a length of perhaps 20 miles. Once the junction has fairly been made, the Snake River proceeds to cross Idaho to Oregon in a mighty half circle. It then goes on its course to meet the Columbia and finally dissipate its waters with those of that river in the Pacific Ocean. It is in the head-water region in Wyoming, where the elevation above the sea is considerable, that certain reservoirs are to be constructed, and likewise at suitable locations in the Idaho portion of the valley, also.

Jackson Lake has already been mentioned. It is in Wyoming and supplies part of the head waters of the Snake. Here the winter water and the surplus of May and June are held in reserve for use later in the summer and in the autumn. At this one point, the reservoir capacity under control amounted some time ago to 380,000 acre-feet. The area covered by the lake was considerable; so

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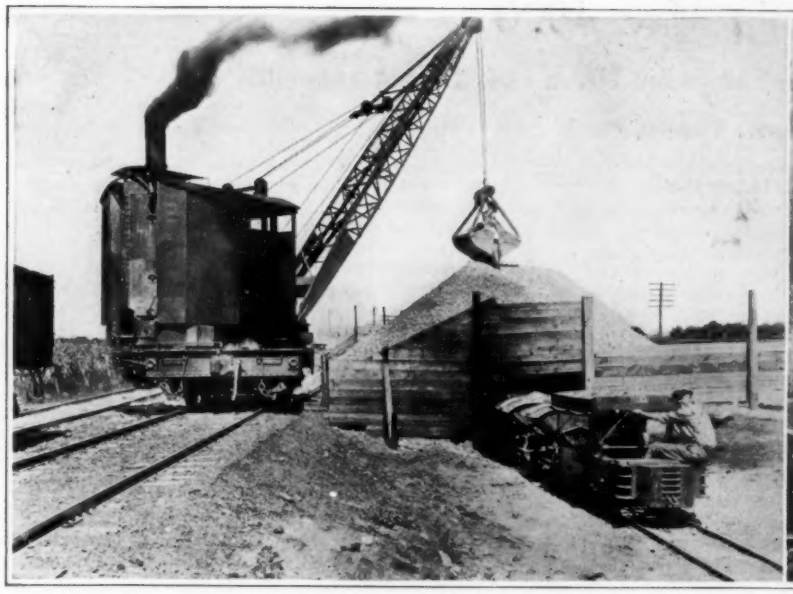
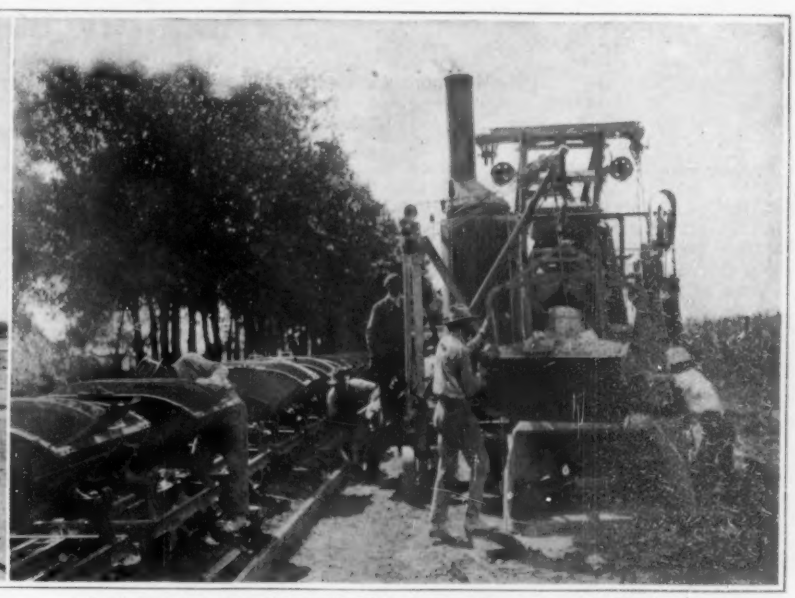


Gravity storage bins and electrically-hauled train of cars for transferring concrete materials to the mixers



A derrick on the side of the mixer lifts the car body from the running gear and dumps the mixture into the skip

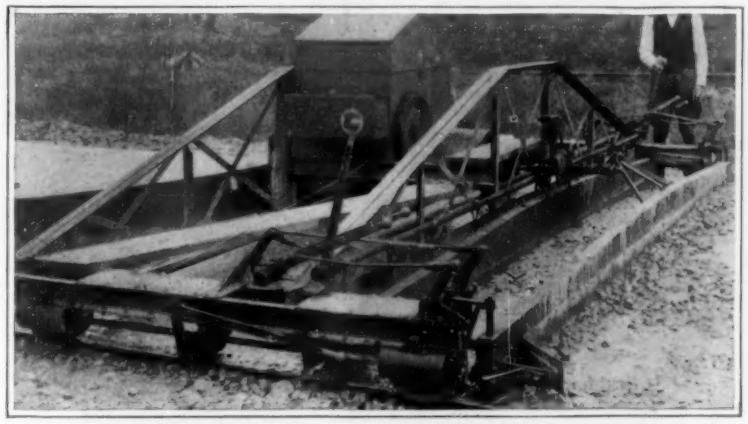
Efficiency In Concrete Road Building

IN view of the present activity in road building, and the enormous sums of money which must be expended in the days to come, it should be the object of the engineer to develop the most efficient methods of doing this great work. In the present article we show a concrete road-building plant which is based upon past road-building experience and aims at rapid, efficient work, and the production of a well-mixed, well laid and thoroughly surfaced concrete, which will stand up satisfactorily under the most trying conditions of weather and hard service. To the civil engineer whose work necessitates the handling of large quantities, the Lakewood method will commend itself as being thoroughly practical and possessing the two prime qualities of time-saving and labor-saving.

The fundamentals of this system are the provision of a large storage yard at one end of the stretch of road which is to be built, and the laying down to one side of the work of a narrow-gage railway for bringing the materials from the yard to the end of the newly finished road, thus keeping pace with the work as it advances. In the storage yard, the broken stone, sand and cement are stored in big piles and hoppers, beneath which runs a tunnel for the charging of the cars. The car bodies are divided into three sections, one for stone, another for sand, and a third for cement, the central (cement) section having a cover to keep out the rain. The batches are hauled out to the end of the work by the train load and transferred to the mixer, as will be later explained.

The first operation in building a concrete road is, of course, to do the sub-grading. Under the old method, before the use of the narrow-gage railway, the custom was to establish piles of material at the side of the road or on the sub-grade, to be used as the construction proceeded, and this resulted in the cutting of deep ruts in the sub-grade and the loss of a certain amount of concrete in filling up these ruts. Under the present method, with a storage yard and a service track, the sub-grade is never disturbed.

The excavation to sub-grade is done by a sub-grader, in which a series of V-shaped knives, six inches wide and from two to four feet in length are mounted beneath a wooden framework. The machine is pulled by a road roller, which packs the loose material which has been spread by the shovellers to fill inequalities.



The road tamping and finishing machine which spreads the concrete, tamps it, and floats the laid concrete to a smooth surface

Since the wheels which carry the grader roll upon the steel side forms, it is possible to finish the sub-grade exactly to the engineer's profile.

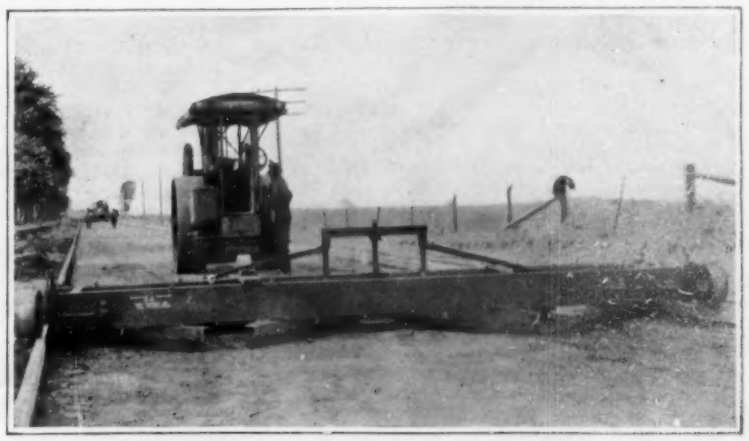
The mixer is provided with a derrick which can be attached to either side and which lifts the car body with its batch from the trucks, swings it around and dumps it into the skip. This means that shovel and wheelbarrow gangs are eliminated and there is no piling up of materials on the sub-grade. Furthermore, since the separate sand, stone and cement compartments hold the right amount for a batch, a uniform concrete mixture is obtained without the time and trouble of measuring them out at the side of the work.

The next element in this plant is the road finisher, which consists of a stiff framework arranged to travel on the side forms of the concrete road. At the front of the finisher is, first, a scraper or leveler which smooths down the concrete to a uniform face. Behind this is the tamper, a heavy plank carried on edge, and spanning the entire roadbed, which has a rather rapid vertical motion that is so effective in its operation that the air entrapped within the material is brought to the surface, and the concrete is thoroughly compacted. The larger stones and the right amount of mortar to cement them are thus brought together. By thus increasing the amount of coarse aggregate the contraction of the concrete is greatly reduced, and the voids being eliminated, a concrete of uniform consistency and greater strength results, as was shown by Prof. Duff A. Abrams in his experiments at Lewis Institute, Chicago. One advantage of this method of tamping is that a drier, coarser mixer may be used that can be worked by hand; in fact, the mixing can be done at a central mixing plant and the concrete hauled long distances without separation of the aggregate.

The smoothing off work of the tamper is done by the strike-off above mentioned, which not only moves horizontally but is arranged to have a reciprocating horizontal movement across the road. The tamper is a heavy kiln-dried and oil-soaked timber, shod with a steel channel. At the rear of the machine is a finishing belt which is attached to a supporting frame, the frame being shaped to the crown of the road. This belt lies on the wet concrete, and as it has a lateral movement back and forth across the

(Continued on page 532)

Placing the steel side forms for a concrete road



The subgrader, which works exactly to the engineer's profile

The Heavens in May, 1920

The Friction of the Tide and Some of the Things for Which It Is Held Accountable

By Prof. Henry Norris Russell, Ph. D.

THE present month is noteworthy for the occurrence of two eclipses, one of which is well visible in our part of the world. This occurs on the evening of May 2nd, and though it will be a past event by the time this issue comes to the reader, we discuss it as a matter of record. As might have been inferred from its visibility at the hour which we shall shortly mention, it is an eclipse of the moon—and total, to boot. The moon passes far inside the earth's shadow, though missing its center, and is entirely obscured for more than an hour. The time of the phenomenon is unusually convenient for observation. The moon first reaches the penumbra at 5:49 P. M. by Eastern Standard Time (or an hour later by the clocks of those cities where daylight saving is in vogue), and reaches the umbra, or dense part of the shadow, at 7:01 P. M.—about the time of sunset and moonrise in New England. By the time the moon has fully entered the shadow she will be fairly high in the sky for eastern observers. The middle of the eclipse comes at 8:50 P. M. If at this time a bright screen could be set up just behind the moon, the earth's shadow on this would be a huge circle, about 5,700 miles in diameter. The moon's center would be 1,350 miles south of the center of the shadow, so that her northern edge would come within some 250 miles of this point, with her southern limb about 400 miles inside the outer limit of the shadow. The moon would be invisible at this time, and throughout totality, if it were not for the refraction of light in our atmosphere, which bends in the rays that nearly graze the earth's surface, so that some light reaches the moon. At the present eclipse, what little light the moon receives will have come over the Antarctic continent. If the weather is cloudy, generally speaking, in that inhospitable region, very little light will get through, and the eclipsed moon will be very dark; but if Antarctic weather is clear the moon will be considerably brighter. At best, however, it will be a mere ghost of its ordinary self. Its brightness at such a time is rather hard to estimate on account of its large apparent size, and the red color of its light. Here for once the short-sighted astronomer has an advantage, for without his spectacles brighter stars may look to him nearly as big as the moon, and be readily comparable with it. Rough estimates by the writer at a previous eclipse indicated that the eclipsed moon was a little brighter than Sirius—which would make it less than one ten-thousandth as bright as under ordinary circumstances. On the present occasion Mars will be not far from the eclipsed moon, offering an excellent standard of comparison for short-sighted observers. Photographically the eclipsed moon is very much fainter in proportion to its normal brightness—which is natural, as the light that reaches it has traversed a great thickness of the earth's atmosphere, as in the case of rays from the setting sun, so that very little blue or violet light gets through.

But while we are discussing it, the eclipse progresses. At 9:27 P. M. the moon begins to emerge from the shadow, and at 10:41 she gets clear of it, though her western edge will be perceptibly darkened by the penumbra for some time longer. Finally at 11:50 P. M. the penumbra is left behind completely, and the full moon shines in her splendor.

The second of the month's eclipses is a partial one of the sun, which happens on the 18th by the reckoning of those parts of the world where it will be seen, though for us the time of beginning falls before midnight, at the end of the 17th. If the moon were but a little farther north, there would be a total eclipse in the Antarctic regions, but as things are the moon's actual shadow misses the earth, though passing within fifty miles of its surface. A partial eclipse is visible over an extensive area, which lies mainly in the southern Indian Ocean, and includes no land to speak of except Australia, where a rather small eclipse is to be seen in the late afternoon.

Vagaries of the Moon's Motion

The only observations of scientific value which can be made during eclipses such as these are those of occultations of stars, during an eclipse of the moon, or of the times of beginning and ending of a solar eclipse, which serve, in either case, to give us accurate information regarding the moon's place in the heavens. Observations of this sort—particularly of the times at which eclipses were seen—have been made from remote antiquity; and we have records of some of them long antedating the Christian era. It is well known that when these are compared with modern observations, it is found that the observed position of the moon disagrees with that calculated by carrying back the moon's present position, at the rate at which she has been moving during the last two or three centuries. Indeed, there can no longer be a doubt that the moon is moving around the heavens at a slightly greater rate per century than she formerly enjoyed. The motion of the moon in longitude during each century exceeds that during the previous century by 22 seconds of arc, which is less than one part in 80 millions of the whole amount; but the effect is rapidly cumulative with the time, and in the 2000 years since the early observations it has shifted the moon by more than a degree from the position which she would have occupied if she had moved uniformly. This "secular acceleration" of the moon's motion was discovered by Halley, more than 200 years ago, but its full explanation is still under discussion. An increase in the amount by which the moon moves in a century may arise either because the moon really moves faster, or because the earth rotates more slowly—and therefore the moon, though really moving at the same rate, seems to cover more ground per day, or per century, since the calendar century consists simply of a specified number of successive days. Laplace, more than a century ago, showed that a part of the observed effect arose from a real increase in the rate of the moon's motion, due to a change in the sun's action upon it, resulting from the change in the shape of the earth's orbit which is produced by the attraction of the other planets. This increase will go on steadily for many thousands of years, but will ultimately slow down and change over to a decrease as the earth's orbit alters in shape.

When its exact amount was calculated, however, it was found that this gravitational influence would account only for an increase in the moon's motion by 13 seconds per century, leaving about nine seconds to be explained in some other way. The most probable hypothesis, recognized for fully a century, is that this remainder arises from a lengthening of our day, due to the friction of the tides, which as they rise and fall must act on the rotating earth very much as a brake acts on a rotating wheel, gradually to slow it down. The case is somewhat complicated by the fact that the tidal "brake" is attached—by invisible but potent bonds of gravitational force—to the moon, so that the reaction of these forces on the moon tends to make its orbit bigger, and its motion slower; but the day is lengthened more in proportion than the month, so that the month, though really *longer*, seems *shorter*, when measured in days; and the moon seems to travel faster.

The Tidal Brake on Earth and Moon

The most recent calculations on the subject, by the English astronomer, De Jeffrays, have just reached this country. They indicate that the moon's motion is slowed down by this influence at the rate of twelve seconds per century—almost exactly the same amount by which it is being speeded up by the gravitational influence discussed previously. So the actual calculated rate of motion of the moon remains practically unaltered. Meanwhile the earth's rotation is being slowed down at such a rate that the moon appears to gain 21 seconds per century on this account—practically the whole observed effect. The resulting change in the length of the day (compared with some imaginary standard clock which runs with absolute uniformity) works out as very slightly more than 1/1000 of a second per century. It seems almost incredible that so very small a change can produce any perceptible effect, but the calculations can easily be verified. Two thousand years ago each day was 1/50 of a second shorter than now, which means that each century was twelve minutes shorter. The average length of a century since that date has been six minutes less than at present, and the net effect of this, over twenty centuries, amounts to two hours—which is the far from negligible amount that the earth, considered as a clock, has lost in this interval.

When we come to calculate how much work has to be done by the frictional forces to slow down the earth's rotation, even at this rate, the results are startling. According to DeJeffrays' computation, the rate at which energy is being transformed is equivalent to 1850 million horse-power! And here arises a serious difficulty, for it is hard to see how the mere rising and falling of the tides can account for so huge a dissipation of energy. But in such a case guess-work is of very little good, and progress is likely to be made only by the careful and intensive study of the tides in particular regions.

Such a study has recently been made of the Irish Sea by an English physicist, Mr. Taylor, who has taken advantage of the exact knowledge of the tidal currents derived from years of hydrographic surveying. He finds, by two independent methods of calculation, that the rate of expenditure of energy by the friction of the tidal currents on the bottom of the Irish Sea during the spring tides averages about 5,000 horse-power per square mile. The average for all states of the tide is half as great, and the area of the Irish Sea is 15,000 square miles. Hence in this one small sea-basin, which occupies hardly more than one ten-thousandth of the whole surface of the oceans, the average consumption of tidal energy by friction is at the rate of between 35 and 40 million horse-power, or one-fiftieth of the total amount which the tides of all the oceans need to furnish to account for the slowing of the earth's rotation.

There is good reason to believe that the tides in the very deep oceans move with very little friction; and the tides of the Irish Sea are unusually high, with the tidal

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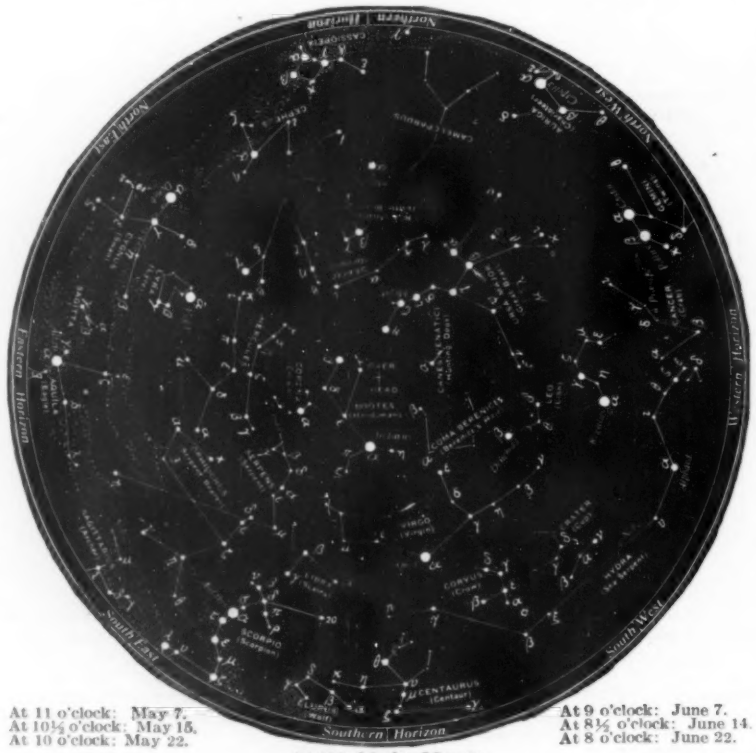


At 11 o'clock: May 7.
At 10½ o'clock: May 15.
At 10 o'clock: May 22.

At 9 o'clock: June 7.
At 8½ o'clock: June 14.
At 8 o'clock: June 22.

At 9¼ o'clock: May 30

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on May 7, etc.

NIGHT SKY: MAY AND JUNE

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

This device bakes the hair into permanent curls and waves

Permanent Curls Baked by Electricity

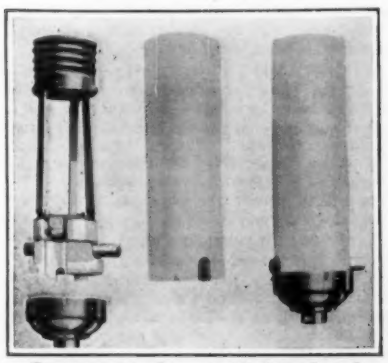
SOME time ago an inventor hit upon the novel idea of applying the electric curling iron on a wholesale scale, and ever since then several types of machines for permanent hair waving have found their way into beauty parlors.

One of these machines is shown in the accompanying illustration. It consists of a battery of electric heating units, each of which takes care of sufficient hair to form one curl. In some instances the patient is protected from the intense heat by an electric blower which is manipulated by the operator. At any rate, this machine and others of a similar nature serve to bake the hair into more or less permanent curls and waves.

An Electric Light Socket That Looks Like a Candle

A NEW socket of the candle length type, with an improved cap catch which enables the socket shell and switch to be attached to the cap by a slight turn of the fiber candle shell, has made its appearance on the market.

The candle, socket and switch can be detached and lifted from the cap by an opposite turn or twist. The illustration shows the fiber candle, socket shell and switch assembly, and cap. The new cap consists of the ordinary socket cap with a concentric sleeve over the enlarged end. Three notches in the sleeve coincide with similar notches in the cap proper, and are spaced to receive three short stubs projecting radially at the bottom of the fiber candle. When the fiber candle is inserted in the cap and given a slight turn, the sleeve moves with it, and the holding stubs of the candle follow horizontal slits in the stationary cap. The candle is therefore locked and held at three distinct points. This insures firmness and stability to the assembled socket, whereas when the candle is held at fewer than three points any disturbance such as jarring or handling sometimes deflects it from its natural upright position.



Components of a recently introduced candle-length socket

Chain Doors as Protection Against Heat

MANY makeshifts have been devised to avoid the adverse conditions arising from the opened furnace door. What has been demanded is a door or shield that would permit a clear, unhampered view of the interior of the furnace or oven; would not in any way interfere with the free manipulation of the tools required to care for the interior; yet a door that would keep the heat in and the cold air out; in other words, a door which should possess at the same time the qualities of opaqueness, transparency and penetrability. This was a seeming impossibility until the chain door was devised by a Baltimore inventor.

A curtain of chain protects the fireman from the intense heat

These chain screen doors, in the form used mostly around metal, glass and chemical furnaces, consist of a multitude of freely hanging individual strands of steel chain suspended close together from a bar to form a continuous sheet or curtain of chain. This curtain of chain, hung before the uncovered opening to a furnace and looking like a coat of mail, effectively hinders the heat, glare, gases and sparks from leaving the furnace and checks the entrance of cold air. The loosely hanging strands of light chain are parted with ease and pressed aside by the tools or other objects projected into the furnace, only to fall together again when entrance has been effected. The interstices in the links of chain permit an unhampered view of the interior—in fact a better survey may be obtained than under ordinary conditions, as the glare is toned down and the effect is similar to looking into a furnace through a piece of wire gauze.

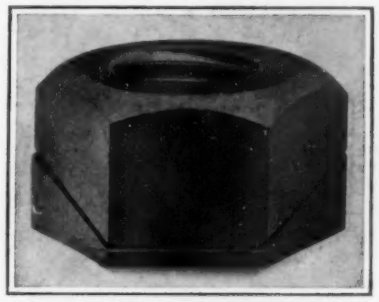
In some plants, when it is necessary to work in front of the naked fire, the workmen are obliged to stand back a great distance from their work and protect their bodies from the heat and glare with large sheet-iron shields which are supported by one hand while the other manipulates the tools. This seriously handicaps the workman and cuts his efficiency in half. In some industries the men are obliged to protect their eyes with dark goggles and their bodies and hands with extra heavy coverings. In those plants where the new chain screens have been employed the workman has both hands available for his work and may, with comfort, freely manipulate his tools while standing within a few inches of his work.

In a boiler room where the chain doors have been employed for about three years, experiments were made to obtain an idea of the effectiveness of the device in avoiding the losses arising from the frequently opened stoking door. A thermometer was fixed on a standard in the fire room at a point opposite this door and 10 inches therefrom. This position was chosen as being near to the one usually taken by the fireman when stoking or cleaning the fire. When the ordinary fire door was thrown open and the incandescent fire bed exposed, as is the case whenever the furnace is coaled or cleaned, the thermometer rose to 400 degrees Fahrenheit. On covering the furnace opening with the auxiliary "chain door," the temperature dropped to 135 degrees, and the bare, unprotected hand could be held anywhere in front of the screened opening without discomfort.

Chain screen doors are supplied in "automatic" and "non-automatic" forms. The automatic is employed mostly on boiler furnaces and is so constructed that the opening of the fire door trips a catch, which permits the screen to unroll from a cylinder, and fall in front of the furnace opening. The "non-automatic," much used on ovens and other furnaces that are not so frequently opened, is much simpler in construction.

Another Lock Nut

IN a compilation of inventions by classes, the class having to do with lock nuts and "stay-put" devices would loom up as one of the leaders. For it is a fact that many, many patents have been granted on "stay-put" devices of all sorts—and more are coming along day by day.



The saw-cut at an angle causes this nut to lock when drawn up tight

In the accompanying illustration we present a type of lock nut that has met with wide application because of its dependability. It is claimed to lock itself positively in position as it is tightened against the shoulder of the work, and does away with spring washers and the old-fashioned double lock nut. Nuts of this kind are being employed by the manufacturers of automatic looms where the vibration is excessive; on automobiles, where the service is severe; on railroad crossings and switches, in which case two and a half years of service has had no effect on the tightness; and so on, with satisfactory results. Yet the device consists simply of a plain nut with a saw cut at an angle, as shown in the illustration. This simple expedient evidently causes the nut to lock on the stud or bolt when it is tightened in place.

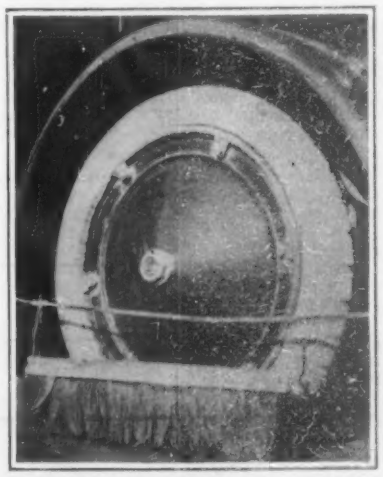
Electrically heated knife used for cutting the compound of storage batteries

An Electric Hot Knife

A GAS flame and a putty knife have been the usual method by which batteries have been opened. A new method makes use of an electric hot knife. The blade of knife has a narrow slit extending down the center of it. Through this slit flows current, heating the blade to a proper temperature. Most of the heat is concentrated at the tip of the blade where it is conducted away most rapidly when in use. A special patented alloy is used to make the blade and is said to have sufficient mechanical strength even when heated red hot.

When the Automobile Wheel Will Not Splash

SOMEONE who must have a certain amount of consideration for pedestrians has equipped his automobile with the simple splash fender shown in the accompanying illustration. This device consists simply of a heavy, broom-like member suspended from a rope in front of the wheel. Obviously, four splash fenders are required for a car, since each wheel must be screened. The straws of the broom effectively mask the bottom of the wheel, holding back all water and mud, while they do not interfere with the forward movement of the automobile.



A length of heavy broom acts as splash fender for the autoist

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Apparel

NECKTIE HOLDER.—E. J. HAMILTON, Baltimore, Md. The invention has for its object to provide a device for use with turn down collars, wherein a support is provided upon which a four-in-hand or tie may be tied, the support being adapted to fit between the folds of a collar with the tie at the opening at the front of the collar, the support having means for engaging a collar button to prevent displacement of the tie.

Pertaining to Aeronautics

AIRCRAFT.—J. WHALEN, 819 Belden Ave., Chicago, Ill. The invention relates to an aircraft capable of use either as an airboat or air-land machine and resides more especially in a propeller embodying the helicopter principle. An object is to provide an aircraft of reliable stability and large weight carrying capacity. Another object is to provide an aircraft sustained, stabilized and propelled by the joint action of the forces produced by instrumentalities separately employed therefor in the lighter-than air and heavier-than-air types of machines.

Of General Interest

CUSHION HEEL.—B. JACKERSON, 718 Wythe Ave., Brooklyn, N. Y. The primary object of the inventnionn is to provide a cushion or resilient heel for shoes in which the elasticity is produced by means of a pneumatic element suitably mounted within the heel. A further object is to construct the heel in such a manner that the pneumatic element is at all times protected, and the protecting plate retained in position by the inflation of the pneumatic element.

WRAPPER.—R. H. MESTER, 36 Glendale Road, Webster Groves, Mo. The object of this invention is to provide a wrapper especially adapted for wrapping gum and the like, wherein an air-tight wrapper is provided which will prevent the gum from becoming brittle, and will keep it fresh, the wrapper being perforated on lines that will permit the removal of the gum as desired, while holding them in superposed relation and with the greater portion thereof still covered by the wrapper.

TRAP.—J. V. MCCAUGHAN, Long Beach, Miss. This invention relates more particularly to traps used by fishermen for trapping crabs, lobsters and shrimps. One of the principal objects is to provide a trap of this class, which is simple and convenient of arrangement and of such nature that the fish will be readily attracted and easily confined, the trap being inexpensive of manufacture, efficient and durable.

SPOON.—M. GLUCK, 208 E. 14th St., New York, N. Y. The object of the invention is to produce a paper spoon more particularly for use in connection with soda-water fountains. A further object is to provide a spoon with a hollow handle so that fluid might be drawn up into the mouth and the spoon thrown away after having been once used. A further object is to produce a spoon which shall be sufficiently strong that its edge may cut a semi-solid substance such as frozen cream.

BITUMINOUS COMPOSITION.—W. C. EBLER, 515 So. 5th St., Terre Haute, Ind. This invention relates to a composition for making vessels such as are used in storage batteries and similar articles. This composition can be produced cheaply and is not as brittle as the composition usually employed for making such articles, furthermore it can be quickly repaired by the application of heat. The composition consists of Genasco asphalt 12 parts, pitch 6 parts, wheat flour 2 parts, and cement 1 part.

MARINE WATER CLOSET.—H. H. SELL and J. S. BERGER, 415 E. 162nd St., New York, N. Y. This invention has for its object to provide an electrically operated centrifugal pump communicating with the outlet of the bowl operated by an electric motor which also operates a second pump forcing water into the bowl. A further object is to provide a construction of discharge from the bowl which exerts a suction as well as an ejecting action to thoroughly discharge the contents of the bowl.

FISHING REEL.—J. I. SMITH, 841 E. 28th St., Portland, Ore. This invention relates to reels connected with fishing rods, and has for its object to provide a handle for fishing rods, which may be connected with a telescoping rod or with a rod of any other character, and which carries a reel having a brake and folding means for operating the reel.

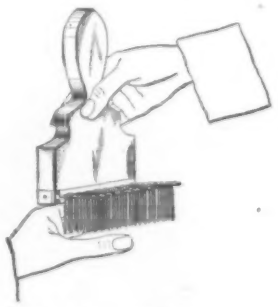
UNWINDING DEVICE.—JENNY ZERVUDACHI NEE RODOCANACHI, Paris, France. This invention has for its object to provide a reel or skein unwinder which can be easily taken to pieces and is constructed of parts which occupy little space, so as to be kept in a work table or work bag and when put together allow of the reeling off of any spun textile material such as wool, which is wound in a skein, without the latter constantly rolling on to the ground and becoming soiled.

SAFETY COMPARTMENT FOR SHIPS.—Y. K. BUELL, Box 926, City Hall Station, New York, N. Y. This invention relates to means for preventing the sinking of a boat if the hull becomes torn open or punctured by shells. The general object is to provide means for inflating the compartments of the ship by compressed air, so that the entrance of water will be excluded and the ship maintained floating.

VENTILATED GRAIN STOREHOUSE.—L. H. DICKELMAN, Forest, Ohio. Among the objects of the invention is to provide a corn crib in which the corn may be effectively cured and which is rat-proof and vermin-proof. A further object is to provide a grain storehouse which is easily set up, and having auxiliary means for introducing artificial heat, so as to overcome the difficulty of bringing the grain to maturity during wet or damp weather.

WATCH HOLDER.—R. F. CHRIST, Idagrove, Iowa. The invention has for its object to provide a simple but efficient holder of the character specified, having means grasping a watch to hold the same firmly, yet in a manner easily releasable, and which is also provided with means for engaging the pocket to prevent accidental displacement of the watch and holder.

NAIL BUNCHER AND ASSORTER.—J. CATINZEARO, 3014 Wentworth Ave., Chicago, Ill. The purpose of this invention is to provide a device which will reduce the time in assorting the nails, and is designed to be used primarily by box makers. The object is to provide a device



VIEW OF THE DEVICE, SHOWING THE MANNER IN WHICH IT IS USED

which will obviate the necessity of picking up the nails by hand and thus eliminate all danger of running the point of a nail into the fingers. A further object is to provide a device which is of simple construction and cheap manufacture.

UMBRELLA.—J. ALLESINA, 451 College St., Portland, Ore. The object of this invention is to provide a runner for umbrellas which will serve the purpose of maintaining the ribs in extended or folded position. To accomplish this the runner is constructed of elongated resilient sheet metal plates with right angle ends, when it is desired to open or close the umbrella the resilient plates are depressed, and the right angle ends strapped behind rings provided and secured near the ferrule and near the handle end of the staff.

CONTROLLING MEANS FOR SAVING SYSTEMS COMBINED WITH INSURANCE PROTECTION.—F. A. GESELL, c/o Los Angeles Athletic Club, Los Angeles, Cal. This invention has for its object to provide a controlling means to safeguard periodical payments made by a depositor to a bank or other depository and to indicate the cash or surrender value of the savings and insurance account at any time. Another object is to reduce clerical assistance to a minimum at the same time providing a simple means which accurately shows the transactions at a glance.

OPERATING DEVICE FOR WINDOW SASHES.—W. P. HILLEY, 316 Locust St., Des Moines, Iowa. The object of the invention is to provide an operating device for window sashes arranged to permit of conveniently raising or lowering the sashes at the will of the operator and locking the sashes in the adjusted position. Another object is to permit of easily and quickly removing the sashes from the window frame for cleaning, repairs or other purposes. Another object is to dispense with sash cords and weights for counterbalancing the sashes.

BED SPRING.—M. NOVICK, 465 6th Ave., New York, N. Y. Among the objects of this invention is to provide a combined bedstead and spring having adjustment longitudinally and laterally to accommodate the mechanism for large persons or to reduce the size to economize space. Another object is to provide a means for maintaining the symmetry and effectiveness of the head and foot pieces of the bed with respect to the handling thereof in various positions of adjustment.

SOAP GRIP.—H. M. APPLEGATE, address I. Warner, Cortelyou Rd. & Coney Island Ave., Brooklyn, N. Y. An object of the invention is to provide an adjustable device which may be made to fit bars of soap varying in size, engaging the bar of soap in such manner that the user may grasp it while holding the soap and rubbing the same on surfaces to be washed so as to gain a firmer grip on the soap to prevent it from slipping or sliding from the hand.

CHALK SHARPENER.—H. L. ROSENTHAL, 55 Fifth Ave., New York, N. Y. The invention relates to a device such as is used by the needle industry. An object is to provide a device which will perfectly sharpen the chalk and perform the function quickly and economically. A further object is to provide a device which permits a convenient assemblage of marking devices, erasing devices, heating means and sharpening means so as to save time in locating these adjuncts of the tailoring trade.

STAGE SEARCHLIGHT.—C. J. TRITSCHLER, 7 Newport St., Lambert, England. The object of the invention is to produce a stage apparatus arranged to produce the effect of a searchlight beam thrown on a distant moving object, such for instance as a miniature representation of an airplane. Another object is to provide a well defined light beam in close imitation of that emanating from a powerful searchlight in actual use for searching the sky for enemy air craft.

STAGE APPARATUS.—V. J. TRITSCHLER, 7 Newport St., Lambert, England. The object of this invention is to provide a stage apparatus, more especially designed for producing the effect of an airplane, dirigible or other air craft traveling in the night, appearing to be set on fire interiorly, with the flame, eventually burning out and the air craft dropping down to earth.

PENCIL POINTER.—W. E. ABBOTT, Bend, Ore. The invention has particular reference to a pencil pointer and paper weight. Among the objects is to provide an implement adapted especially for use by draftsmen, architects, engineers or others who desire to use pencils with long slender points and which are required to be repointed from time to time. A further object is to provide a construction of abrasive elements which are adapted to be readily interchanged after they become warm.

PROCESS FOR THE MANUFACTURE OF ALUMINA.—E. E. DUTT, Jabalpur, India. This invention relates to a process for manufacturing alumina from bauxite, or any other mineral or compound one of the ingredients of which is aluminum. The substances above mentioned are preferably used in powdered form and in proportion as follows: Calcined buxite 400 parts. The alkali metal chlorid used is preferably sodium chloride 351 parts; a calcuim hydrate 222 parts; carbon, preferably coke or charcoal, 40 parts. Another patent has been granted the same inventor, for the manufacture of alumina from aluminous substances such as clay, buxite, or any other mineral or compound, one of the ingredients of which is an aluminum compound. The substances are preferably used in powdered form, as follows: Calcined clay (about 35 per cent $A/_2 O_3$) 300 parts. The alkaline earth metal chlorid is preferably calcium chlorid, 120 parts.

FUMIGATING APPARATUS.—F. DE A. DEL VALLE San Juan, Porto Rico. The invention has for its object to provide apparatus especially adapted to permit the fumigation by cyanid and other poisonous gases without danger of injury to the user, and wherein means is provided capable of being controlled from a distance to release and permit the container to tilt, another means in connection therewith for indicating when the container has tilted.

CRATE FOR BOTTLES.—J. E. MAUDER, West New York, N. J. An object of the invention is to provide a box or crate for holding bottles, such holder being exceedingly strong and cheap to manufacture. Another object is to securely hold the bottles in place to prevent breakage while handling the crate filled with bottles. Another object is to permit of readily making repairs on the spacing device without requiring taking the crate apart.

DOLL.—A. LIZZI, 316 Humboldt St., Brooklyn, N. Y. The invention relates to dolls or like figures having arms optionally movable. The general object is to provide a doll in which the construction of the arms is simplified while at the same time a positive movement may be imparted simultaneously to both arms to cause the same to approach and recede from each other as in clapping hands or striking cymbals.

SCALE.—G. G. and E. L. VOLAND, 48 Trinity Place, New Rochelle, N. Y. The object of the invention is to provide a highly sensitive scale of the beam type for weighing diamonds and the like. The invention includes an arm mounted on a rod which moves longitudinally, the arm being adapted to engage a recess in a weight for shifting the latter on a scale beam, it being possible to remove the arm from the recess in the weight by a rocking movement of the rod.

SHOOTING TRAP.—A. MCMILLAN, 40 Bayard Lane, Princeton, N. J. An object of the invention is to provide means for casting or ejecting pigeons which will release a single pigeon at a time and throw the same in any direction desired. A further object is to provide means for supporting a number of pigeons, means for locating one of the pigeons on an ejector shaft and means for causing the ejector shaft to revolve and throw the pigeon in the air.

PROCESS FOR THE MANUFACTURE OF POTASSIUM CHLORID.—E. E. DUTT, Jalalpur, India. The invention relates to a process for the manufacture of potassium chlorid from feldspar which consists in treating the feldspar with arsenic trichlorid, lixiviating the so-treated mass, dissolving out the desired chlorid formed, then evaporating the solution of potassium chloride.

Hardware and Tools

AUXILIARY DOOR LOCK.—W. A. SHIRLEY, Fort Worth, Texas. The invention has for its object to provide a simple, inexpensive device of the character specified which may be used in connection with any door for securely blocking the door against movement, and as it is small and compact may be carried by travelers to be used whenever desired.

BUTTON HOLDING CHUCK.—P. F. DUSHA and A. FEYK, 1799 1st Ave., New York, N. Y. This invention relates to chucks such as are employed for holding buttons in the manufacture of pearl buttons. Among the objects is to simplify the means for adjusting and locking of the button supporting abutment members so as to render it unnecessary for application of a tool into or through the lower end of the spindle, the spindle being normally locked in place in the main portion of the machine in such position as to render access thereto relatively difficult.

CLOSURE FASTENER.—C. M. WILKINSON, Hartford, Conn. The invention relates more particularly to bolts for doors, windows and the like. An object is to provide a bolt adapted to securely lock the closure such as a door or window, in closed position, and which may be easily set to lock the door or window ajar or in a slightly opened position. The device as manufactured being durable and inexpensive.

CASKET HINGE.—G. R. KNIGHT, Pittsburgh, Pa. This invention has for its object to provide a hinge by means of which the cover of a casket may be hinged to the body without interfering with the ornamentations of the casket and wherein the hinge is so arranged that by the pressing of a button the hinge sections may be detached to permit the cover to be removed bodily from the casket.

CUTTER HOLDER.—E. W. MINER, 5 Alden St., Hartford, Conn. This invention relates to cutter holders for lathe or other machine tool cutters, and has reference more particularly to a device comprising a shank, a block associated with the shank and capable of movement in one direction, the block having means for carrying a cutter, and a spring member connecting the shank and the block. The cutter is yieldingly held to prevent undue wear and injury.

(*Continued on page 526*)

RECENTLY PATENTED INVENTIONS

(Continued from page 524)

Machines and Mechanical Devices

CURRENT MOTOR.—J. F. LAYCOCK, Huntingdon, Tenn. This invention relates particularly to what may be termed a current motor, and has for an object the provision of a construction which will utilize either a deep or shallow, or fast or slow moving body of water to produce power capable of use in commercial pursuits. Another object is to provide a current motor forming a single element or structure which may be used alone or in connection with similar structures.

ROAD WORKING DEVICE.—W. D. MILLER, Saco, Mont. The invention relates to that class of road-working devices which embody in their construction a frame with a plurality of scraping blades mounted on the frame and adapted to act as a drag when pulled over the surface of the road. The primary object is to provide an adjustable device which will deposit the dirt accumulated in front of its scraping blades in the low places in the road, and thus effectively level the surface.

RIVETING APPARATUS.—E. T. REYNOLDS, 516 Essex St., Brooklyn, N. Y. Among the principal objects which the invention has in view are to provide means for magnetically supporting metal working tools in service, to provide for absorbing shock incident to the operation of tools such as pneumatic hammers or riveters, to heat one rivet simultaneously with the setting of another rivet, and to reduce manual labor in riveting or similar mechanical operations.

WAVE MOTOR.—J. H. MARTIN, Los Angeles, Cal. This invention has for its object to provide a simple, inexpensive but efficient motor of the character specified, composed of units which may be arranged in batteries, to provide a machine of any capacity wherein the intermittent movement of the waves is transformed into the continuous movement for power purposes.

STOCK REGULATOR FOR PAPER MAKING MACHINES.—W. P. FERNEY, 32 Elm St., Hudson Falls, N. Y. Among the principal objects of the invention are, to vary the supply of the stock from which the paper is made in correspondence with the volume of the stock used, to avoid leakage, in the cut-off mechanism with which the regulator is provided, and to provide a float for operating the cut-off mechanism so as to avoid any leakage.

AUTOMATIC STOP FOR SEWING MACHINE.—J. SHAPIRO, 131 Scholes St., Brooklyn, N. Y. The object of the invention is to provide means which will automatically operate upon the breaking of the thread of the sewing machine to throw off the driving power. More specifically the object is to provide a clutch throwing mechanism operated by a positive movement from certain of the driven elements of the machine when the same are connected thereto.

CONCRETE MIXING APPARATUS.—A. J. POWERS, 624 Lincoln Way, E. South Bend, Ind. Among the principal objects which the invention has in view are, to employ the surplus power of an elevator employed in lifting concrete for mixing the same, to provide means for dumping the mixer and the load carried thereby when the same has arrived at its destination, to discontinue and resume the operation of the mechanism at will, and to simplify the construction.

SANDPAPERING MACHINE.—N. M. DELONG, 101 4½ St., S. W., Washington, D. C. The invention relates generally to surfacing machines, and more particularly to sandpapering machines, the primary object being to provide a machine for sand papering mouldings including an arrangement by which the edges between vertical, curved, and horizontal surfaces may be cut sharp and clean and generally better results attained.

ROAD GRADER.—J. B. HODGES, Shangle, Wash. The object of the invention is to provide a road making machine of such nature as adapts the same for use as a grader, leveler, snow scraper and the like, a further object being the production of a simple and durable device, capable of ready and quick adjustment and effective in use.

SULFUR-FEED HOPPER.—H. S. CLERC, 328 Lafayette St., Gretna, La. This invention relates to sulfur feed hoppers of the kind used in connection with furnaces for burning iron pyrites or other sulfur ores, or in connection with furnaces used in making sulfuric acid. More particularly the invention comprehends a hopper and box so arranged that the device may be readily mounted upon the furnace that the heat melts the sulfur contained within the hopper which flows in small quantities into the furnace.

JACQUARD MACHINE.—F. GLATZEL, 22 Sherman Ave., Paterson, N. J. The object of the invention is to provide a machine whereby the bearings for the frame carrying the card cylinder are relieved of the weight of the card cylinder to prevent binding of the frame in the bearings and to insure an easy reciprocating movement of the frame thereby reducing the wear and tear to a minimum. Another object is to permit of applying the device to a jacquard machine as now generally constructed, without requiring changes in the parts.

PROCESS OF AND MACHINE FOR TREATING FLAX-STRAW AND THE LIKE.—I. ETRICH, Oberaltstadt, near Trautenau, Bohemia. The invention relates to a machine for the treatment of retted vegetable fibrous bast material such as flax straw, short flax stalks, flax tow, hemp and the like, which owing to the shortness of its elements, cannot be scutched and has for its object to produce from such raw material in one continuous operation a pure material for spinning purposes. A notable feature of the machine is that it requires but little and unskilled attention while being operated.

HECKLING MACHINE.—I. ETRICH, Oberaltstadt, near Trautenau, Bohemia. This invention relates to a heckling apparatus for dividing and thoroughly cleaning flax, hemp and similar fibers, for making them ready for further treatment on carding machines. The apparatus is suitable for any swingled or scutched bast fibers and is preferably attached to the swingling or scutching apparatus so that the material is delivered from the latter immediately into the hackling apparatus.

STEAM HAMMER ATTACHMENT.—M. E. TIBBELS, Fremont, Ohio. The object of the invention is to provide an apparatus with simple and efficient means controllable from the operating treadle, for closing the throttle when the treadle is released, and for opening it to working position prior to the beginning of the downward movement of the treadle, to limit unnecessary consumption of motive fluid while waiting for a heat or any other purpose.

Prime Movers and Their Accessories

VALVE LIFTER.—H. KVINDLOG and C. O. WOTRING, address Louis Hallum, Aitkin, Minn. The invention relates to a form of valve lifter for use in connection with internal combustion motors, for dismantling and removing tappet valves. The object is to provide a lifter capable of quick and convenient application for placing the usual valve spring under compression so that the retaining pin and spring seat washer may be removed so that the valve may be ground clean or repaired.

INTERNAL COMBUSTION ENGINE.—O. G. ERICKSON, 1032 Majestic Bldg., Detroit, Mich. Among the objects of the invention is to provide an independent casting arranged to serve the combined function of a valve cage and a means for mounting or securing a portion of the intake manifold in place. Another object is to provide an engine embodying a novel construction of the valve cages, on top of the engine cylinders, wherein the intake and exhaust valves are disposed in opposition to each other and movable into the explosion pocket surmounted by the spark plug.

VALVE MECHANISM FOR ENGINE.—T. W. DELANEY, Lake Elmo, Minn. This invention has particular reference to internal combustion or similar engines having reciprocating pistons. Among the special objects thereof is to provide a form of rotating or oscillating valve mechanism to control the admission and exhaust from the several cylinders. A further object is to provide a cage or guide for a reciprocating puppet valve.

PISTON.—R. SAITTA, 1534 B. Magazine St., Honolulu, Territory of Hawaii. The invention relates more particularly to piston construction adapted for use in internal combustion motors, wherein pistons and piston rods are mounted in operable relation one with the other. An object is to provide a piston fitted with a piston rod which will dispense with the usual wrist pin bearing, and provide a more suitable and flexible type of bearing connection between the piston and connecting rod.

SPEED RESPONSIVE DEVICE.—I. CRABB, Independence, Iowa. The invention more especially relates to speed responsive devices operated by variations in centrifugal force produced by variations in speed of rotation, and is especially adapted for use on internal combustion engines. An object is to provide a governor which is extremely sensitive in its operation, can be readily attached to a rotating element, yet is simple in construction and cheap to manufacture.

COMBUSTION ENGINE.—W. L. CORLISS, 228 E. 33d St., New York, N. Y. Among the objects of the invention is to provide an engine comprising a pair of cooperating rotors in a compound casing each rotor constituting an abutment for the other or between which there is a direct propulsive effect of the driving medium. A further object is to provide a casing constituting a combustion chamber, and in or with relation to which there operates an automatic reciprocating compresser for mixing gases that are received from the source of supply and delivered to the combustion end of the casing.

Pertaining to Recreation

GAME DEVICE.—K. HASSLINGER, 2082 Prospect Ave., Bronx, N. Y. The particular object of the invention is to provide a device which includes a tethered aerial projectile, and an objective for said projectile which embodies a series of individual point indicating characters which are adapted to be engaged by the projectile when the same is impelled by a person playing the game, for indicating the points gained by the players.

TOY.—V. E. FARMIER, Forney, Texas. This invention has for its object to provide a toy of the motion type, wherein a figure is mounted on a wheeled support and is controlled by the movement of the vehicle to move in imitation of the normal movement of the figure.

Pertaining to Vehicles

AUTOMOBILE SIGNAL.—S. PAINTMAIER, Box 622, Oxnard, Cal. The invention relates more particularly to a signaling device which is adapted to be secured to any convenient part of an automobile and operated by the chauffeur to

A VIEW IN VERTICAL SECTION ILLUSTRATING THE DEVICE

indicate to other cars his intention as to the manipulation of his car. An object is to provide a device employing semaphore signals with means for operating from an enclosed casing to a horizontally extended position and secure the semaphores in such position.

HAND WHEEL.—H. W. DOVER, Northampton, England. The inventor has been granted two patents relating to hand-wheels, such for instance as are employed for steering motor vehicles, for the operation of stop cocks, controlling aircraft, motor boats, gun mechanism, and for other purposes. The object is to provide a construction of this kind capable of being produced as a whole, irrespective of the size of steering pillar or other spindle to which it is to be fitted, and irrespective of the type of hub fitting which may be required. The upper half of the wheel is formed of stamped or pressed sheet metal which extends completely over the central portions of the wheel and is secured by bolts which pass through apertures to the lower half whereby the complete wheel is secured to the steering pillar.

METHOD OF AND APPARATUS FOR HAULING LIMBERED VEHICLES.—T. H. BRIGG, London, England. The invention relates to a method of hauling gun carriages, service wagons and the like drawn by horses or any other animals. The invention is, however, equally applicable to limbered vehicles drawn by mechanical tractors. An object is the provision of an apparatus for securing a maximum efficiency in enabling horses to transport themselves and their loads with the greatest ease and comfort on all the varying conditions of the roadway.

DETACHABLE RIM FASTENER.—H. J. PRESTON, 30 E. Empire St., San Jose, Cal. This invention particularly relates to fastening lugs for wheel rims. An object is to provide a fastening means involving a lug and appurtenances thereto, the use of which will accurately center the rim and positively prevent creeping. This object is attained by providing a lug which in addition to its primary fastening function, is provided with a secondary fastening means to secure the detachable rim at a point distant thereby providing with each lug two points of engagement with the rim.

DOOR LOCK.—J. E. FISHER, Standish Hotel, Denver, Colo. This invention may be embodied in locks for different purposes, but is more particularly intended for the doors of automobiles and other vehicles. An object is to provide a lock in which the bolt is restrained in the retracted position when the door is open and automatically released and projected to the locking position by the closing of the door. A further object is to provide a bolt which will tend to prevent rattling of the door.

DIRIGIBLE HEADLIGHT.—E. A. TOWSEND, 2116 7th St., Tuscaloosa, Ala. The object of the invention is to provide mechanism especially adapted for use with motor vehicles for constraining the headlights to turn with the wheels, in order that they may illuminate the road directly in front of the car, and wherein means is provided capable of being operated from the driver's seat for varying the connection between the wheels and the headlight so that the headlights will turn to a greater or less degree, in accordance with conditions.

SPARK AND THROTTLE LEVER LOCK.—J. H. PRICE, 322 N. Ellis St., Cape Girardeau, Mo. The invention relates particularly to an ignition and throttle lock for Ford machines, the object being the provision of an inexpensive device which may be readily applied and removed and which will in its operative position effectively prevent manipulation of either the throttle lever or the spark lever from the fully closed and retarded positions respectively.

HEADLIGHT.—E. M. SMITH, 1105 Fountain Ave., Birmingham, Ala. The object of the invention is to provide auxiliary lights connected with the steering gear in such manner that when the wheels of the vehicle are turned the headlights will follow the turning movement to direct the rays thereof onto the road. The auxiliary lamps are intended for use when the large head lights are dim, or not in use.

DETACHABLE SHIELD.—H. H. ILLICH, 789 W. End Ave., New York, N. Y. One of the objects of the invention is to provide a self-contained shield of simple construction which may be conveniently applied to another wind shield when used in connection with an automobile, to protect the eyes of the driver from the reflection of bright rays, and in rainy weather to furnish a protecting shield which will keep a portion of the glass clean and protect it from the rain.

TIRE REMOVING TOOL.—C. C. F. REININGER, Franklin Square Road, R. F. D., No. 1., Hempstead, L. I., N. Y. Among the principal objects of the invention are to lift the bead of the tire shoe from engagements with the tire rim, and to move the disengaged bead portion laterally to avoid marring the finish of the rim and filly, and to adjust the tool to time the pulling operation by which the bead is moved out of line with the rim.

SPRINGING OF VEHICLES.—A. J. ADAMS, Heywood, Near Westbury, England. The invention relates to the springing of road and other vehicles wherein the vehicle frame is attached to the axle by means of bell-crank levers arranged in pairs the member of each pair being pivotally connected together, and wherein a spring is provided to resist relative movement of these levers about their pivotal connection.

DEMOUNTABLE RIM.—L. FRIEDMAN, 247 Madison St., New York, N. Y. The invention relates more particularly to securing tires to vehicle wheels, it is particularly adaptable to wheels of the demountable rim type, and has for its primary object to provide a construction which will permit of a ready attachment and removal, and means by which the rim is given a movement circumferentially of the wheel to tighten the rim thereon.

LOCK FOR MOTOR VEHICLE STEERING GEARS.—I. N. SMITH, 123 Orchard St., Newark, N. J. The primary object of the invention is to provide means for attachment to the steering gear of a motor vehicle to render the same inoperative, and thereby prevent unauthorized operation of the motor vehicle. A further object is to provide a device of this character which is capable of attachment to any type of motor vehicle steering gear.

CATERPILLAR GUN CARRIAGE.—E. RIMAILHO, Paris, France. This invention relates to a caterpiller gun carriage forming a complete artillery unit so constructed as to permit of removal over all sorts of ground. The device consists essentially of a chassis having a longitudinal opening and provided with rollers which roll over the caterpillar chains actuated by driving wheels moved by a motor located on the gun carriage itself or on a trailer wagon.

The World's Greatest Vehicular Tunnel

(Continued from page 510)

gravel. The Rotherhithe tunnel has a span of 1,570 feet between ventilating shafts, whereas the present project will have an interval of 3,800 feet beneath the tide and between the offshore ventilating shafts. Therefore, where the British structure answers admirably with only a natural circulation of the air, the engineers in charge of the New York-New Jersey project must stimulate atmospheric movement by artificial means.

To this end, there will be four ventilating shafts; two are to be placed near the pierhead lines, one on each side of the river with inshore shafts situated closer to the tunnel entrances and exits. To ventilate both tubes when the tunnel shall be operating at capacity there will be provided 65 electrically-driven fans. These blowers will be so equipped that it will be possible to regulate the volume of air delivered into the tunnel; and the apparatus is expected to be ample enough to effect a complete change of the air, if needful, 32 times an hour. In passing, it should be remarked that the size of the tunnel decided upon was influenced by the question of ventilation—exhaustive studies disclosing that a 29-foot tube could be ventilated for a good deal less than a tunnel of a foot or two smaller diameter, largely because of the availability of bigger air ducts and the consequent reduction in the power required to offset the "wire-drawing" action. As it is, the operation of the ventilating system at maximum capacity will call for the annual expenditure of $280,000.

While the twin-tube vehicular tunnel is designed to accommodate both horse-drawn and automotive vehicles, it is more than likely that the exigencies of service will limit its use in the course of a few years to power-driven conveyances, which will impose a ventilating problem of getting rid of exhaust gases from a rapidly-increasing number of motor trucks and automobiles. The estimates provide for a movement through each tube in the first year of 119,000 horse-drawn vehicles and 2,686,000 motor vehicles, and in the tenth year the figures show a potential one-tube traffic of only 68,000 horse-drawn conveyances as against 5,916,000 motor vehicles. At the end of the second decade of activity, the dual route should be handling a total of 15,800,000 power-driven conveyances in the course of a twelvemonth. Mere numbers, however, do not tell the whole story. The carrying capacity of the average truck is bound to increase both because of the economic returns thus made possible and the widened zone of automotive operations. The bigger the vehicle the more powerful the engine needed to maintain a satisfactory speed—hence an augmented quantity of gas which must be diluted by an inflow of fresh air and a prompt removal of the vitiated atmosphere. These demands have been anticipated in the plans of the designed ventilating installation. Power for the functioning of the electrically-driven blowers will be obtained from commercial companies serving contiguous New York and New Jersey, and, with suitable reserve units available, a breakdown at any of the central stations will not interrupt the working of the ventilating equipment.

This vital problem of ventilation has received and is still the subject of intensive investigation; and in pursuing the pioneer inquiries demanded in the present case, the joint Commissions have obtained the coöperation of the U. S. Bureau of Mines and certain recognized experts. Painstaking experiments have been made at the Bureau's laboratories in Pittsburgh, Pennsylvania, and at Yale University. At the former place the line of inquiry has been confined to the physical aspects of the matter, *i. e.*, determining the amounts and composition of the exhaust gases emanating from passenger cars and trucks under varying loads, gradients, speeds, etc. At Yale, on the other hand, the information sought has had to do with the physiological effects of the gases over varying periods of time and agreeably to the percentage present in the air breathed.

The outstanding cause of potential trouble is, of course, carbon monoxide, which is the only gas in the exhaust of an engine using gasoline likely to induce toxic action upon either human beings or horses passing through the vehicular tunnel. According to the results of the researches at Yale—assuming a vitiation at different points in the tunnel amounting to from 1 to 6 parts of carbon monoxide in 10,000 parts of air—the physiological consequences to passengers and animals in motion will be not worse than a continual exposure to a uniform concentration of 4 parts in 10,000. This may be borne safely, comfortably, and without disagreeable effects for an assumed maximum standard exposure of 45 minutes. Passenger cars, when making the run through the tubes at a time of densest traffic should not take at the outside more than 15 minutes. So little gas would be absorbed in that time that it is authoritatively stated that the arrangements promise abundant protection for even children and invalids.

The preliminary calculations made by the chief engineer and his associates were based upon furnishing a movement of air that would hold down the average vitiation to 3 parts of gas, and to this end the ventilating plant is designed to be equal to renewing the atmosphere in each of the tubes once every two minutes. The physiological studies show that this safeguard is in excess of requirements. Accordingly the equipment provided will answer fully should future motor trucks be found responsible for a greater volume of objectionable carbon monoxide. Further, there is reason to believe that the work at Yale justifies the assumption that the power for efficient ventilation will be less than originally contemplated. This, of course, will keep down the charge for electrical current. These facts are heartening to the public, for they disclose how thoroughly the matter of ventilation is being looked into and planned for; and there is no warrant, whatever, for the assertion made a while back, that the opening day of the vehicular tunnel would be marked by numerous fatal cases of asphyxiation. Needless to say, the ventilating data is based upon occasional halting of the vehicular movement by traffic breakdowns of one sort or another; and due allowances have been made for carbon monoxide given off while cars and trucks are idling, advancing slowly, or accelerating.

The entrances and exits for the two tubes will be so arranged that the neighboring portals for inbound and outbound traffic will be separated by intervals of several blocks. This disposition is calculated effectually to prevent congestion and to facilitate the utmost possible use of the capacity of the twin route. The entrance and exit gradients present no obstacles to the easy travel of even heavily laden trucks or horse-drawn vehicles. The maximum adverse grade for westbound traffic is 3.5 per cent and that for eastbound movement, 3.52 per cent. These grades are comparatively short, extending only from the portal to the point where the tunnel roadway meets the street level. To minimize crowding and to promote the headway of travel at these points the width of the roadway will be increased so as to accommodate three lines of vehicles. The long adverse grade from the pierhead line to the portal on the New York side is 3.13 per cent, while on the New Jersey end it does not exceed 2.83 per cent.

The estimated cost of the tunnel struc-

ture alone is $22,262,000, which will be divided equally between the two States concerned; and the time required for construction is placed at 3½ years. The figures show that operating revenue, based upon the present ferry charges for vehicles, will yield a return in eleven years large enough to amortize the outlay for the tubes; and at the end of twenty years each State will have to its credit a surplus amounting to $33,635,000—ample to provide, without a tax upon the people, for the building of another double-tube vehicular tunnel.

The Langmuir Condensation Pump

(*Continued from page 511*)

pressure means in terms of molecules, suppose each molecule of air enlarged to the size of a fine grain of sea-sand or $\frac{1}{100th}$ of an inch in diameter. How big a beach could be made from the sand corresponding to the contents of a cubic inch of air at atmospheric pressure? It would make a beach extending from New York to San Francisco, one thousand feet wide and over ten feet deep. Had it been on such a beach as this that Alice's friends were strolling when the Walrus put his hypothetical question of seven maids with seven mops sweeping for half a year, there could have been no doubt in the Carpenter's mind of the futility of their suppositious efforts. And yet by the aid of the Langmuir pump, assuming the sand were air again, that magnificent beach could in a few minutes be reduced to an almost invisible line only two grains broad and one grain deep.

A Forward Step in Automotive Fuels

(*Continued from page 512*)

pected to do so. It is quite the same as the analogous case of reinforced concrete, where we have a combination of cement, broken stone, and steel, together with a binding medium, such as water. Now it is quite evident that with the elimination of any of these constituents it would be impossible to obtain the final product of reinforced concrete and so it is in the case of the new fuel, where the advantages of the several constituents go to assist in eliminating their several disadvantages, so that when acting as a unit, ideal performance is forthcoming. The result of extensive tests carried out with this fuel have definitely pointed out that it is entirely practical.

It is important to note that alcogas is almost ideally homogeneous, practically the entire volume distilling off at the initial boiling point of the fuel. This is evidently of great importance in the elimination of oil contamination, a factor in causing poor lubrication and high oil consumption. The results of tests have clearly demonstrated that it is possible to obtain as much as 25 per cent greater thermal efficiency, together with increased power and better fuel economy per volume. It was also noted that considerably lower engine temperatures are obtained, together with the greater satisfaction of smoothness, noiselessness, and cleaner operation. Above all, and probably of greater interest to everyone, is the fact that carbon troubles are entirely eliminated.

In conclusion, probably the greatest factor at this time regarding this important contribution to the industry is the fact that while the new fuel operates the engines at present available more economically and more efficiently without any changes except those of ordinary carburetor adjustment, it falls in line for meeting the engine requirements of future design.

A Telephone to Europe?

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The attention of readers is particularly drawn to the fact that General Squier did *not* prophesy the coming of a telephone line laid under the ocean, and that he has *not* suggested the immediate laying of

a bare-wire cable to make such a development a commercial fact. The matter is of importance because daily newspapers, with the best intentions doubtless, but with a frequently garbled and almost always meager knowledge of scientific facts, have seized upon this possibility and developed it upon paper as a certainty. It would surprise no one to see shares offered in a transoceanic telephone company tomorrow, as a result of this unwise and untrue publicity.

General Squier is far too able a scientist, and with much too great a reputation in the scientific world, to make any predictions of so startling a character in the face of the facts, which are merely that the experiments, as far as they go, and the principles, so far as they have been formulated, seem to indicate the *possibility* of inter-continental telephony. What no newspaper has featured is General Squier's succinct and careful statement: "The phenomena associated with the transmission of high frequency waves over bare wires in earth or water are obscure and complex and the speaker has formulated no definite theory at the present time." Nor did newspapers underscore any words in reporting his statement that the Signal Corps experiments have "demonstrated the possibility of transmitting electromagnetic waves along bare wires submerged in water." Yet "possibility" is the keynote of that sentence.

It is certainly, in the light of these experiments, conceivable that a way will be found for the use of "wired wireless" for telephone conversations with the ocean itself as an "insulator" for a bare wire which conducts the high-frequency oscillations of radio energy. Unquestionably such a consummation is devoutly to be wished, and this idea seems to promise the way, which the cable never did promise. But we are so far from the fact at present that all publicity leading to the discussion of such a project as about to be accomplished is undesirable and unscientific.

Harnessing Our Waterpower

(*Continued from page 515*)

local consumers in Detroit, which is just across the river from Windsor. It is authoritatively said that the block of energy supplied Windsor from Niagara Falls is sold profitably at a lower price than it could be produced in that city by a steam plant. The success of the Ontario Hydro-electric Power Commission has inspired it to undertake the construction of additional costly installations.

About eight years ago the Bureau of Corporations of the then Department of Commerce and Labor stated that the efficiency of water turbines at the time was probably not in excess of 75 per cent, and it was implied that an efficiency of 90 per cent was something to look forward to in the more or less distant future. It should be a source of gratification to us to know that native genius has achieved so much in the meantime that we have today turbines capable of developing a maximum output of nearly 95 per cent; and thanks to carefully wrought improvements in design it is probably no exaggeration to say that the water turbine ranks as the most efficient prime mover now in service. Because of this advance; the greater simplicity and ruggedness of the machines; and the fact that current can be transmitted profitably for such long distances, we have the soundest of reasons for encouraging hydroelectric installations.

Turbines are now built which will do good work with heads of water ranging from 10 feet up to 745 feet; and we are told that there is no reason why they should not be produced to operate under a head of 1,000 feet. By reason of this scope of adaptability, turbines are classified as low-pressure, medium-pressure, and high-pressure apparatus; the first taking heads up to 75 feet, the second

dealing with a fall between that and 150 feet, and the third class working from 150 feet upward.

Where conditions favor, hydroelectric energy can be furnished at a considerably lower rate than when the primary source of power is either coal or oil; and it is upon an abundance of relatively cheap energy that many of our existing and evolving activities depend. It was by utilizing Niagara Falls that we called into being our electro-chemical industries; and we shall not be able to maintain our supremacy in this very important field of commercial life unless we profit by nature's bounty and make the fullest use of our flowing and falling waters. Undoubtedly there are many thousands of miles of our railways, now using steam propulsion, which could be run better and for less money if they were energized by hydroelectric plants. Finally, the substitution of power from water for that produced by fuel means a momentous gain in atmospheric cleanliness and, consequently, in the physical wellbeing of the populace.

Succeeding in Mining Engineering

(Continued from page 516)

pendent for success upon achievement. They are judged by more exacting standards than men in other professions. A doctor may ascribe the death of a patient to the will of God; a lawyer may urge the extenuating circumstances when he loses a lawsuit to the stupidity of the judge or the corruption of a jury, but an engineer is held directly responsible for results."

No man following this profession should have an ambition so mean and small that it concerns only himself. Men of this caliber seldom reach high standards in their profession. It is the big, broad-minded, unselfish man with large wholesome ambitions who succeeds beyond the wildest dreams of those whose ambitions concern only themselves.

A final word to those who feel that they have the courage, sincerity of purpose, and other necessary qualifications to enter the field of mining engineering and yet have not the advantage of attending college. There is always a place for the earnest, conscientious, hardworking fellow with an appetite and yearning along the lines which he feels his life's calling to be.

A New Microphone Hummer for Electrical Tests

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by a floating type of spring. This combination of springs enables the button to withstand severe shocks, yet it has sufficient inertia so that perfect operation is obtained. This type of mounting, together with the fact that the electrical constants of the circuits have been adjusted to their optimum values, insures the continuous operation of the hummer without heating. All adjustments, including that of the microphone button, are permanent.

As the weight of this instrument is but four and one-half pounds and its dimensions but 6 by 5 by 5 inches, it is a much more convenient laboratory instrument than the older and more clumsy ones. In addition to its use in bridge measurements this hummer has been used as a reference standard in determining the frequencies of oscillating circuits.

Watering Idaho's Desert

(Continued from page 520)

that, to get an available storage capacity of 75,000 acre-feet, it was necessary to raise the water level only 17 feet. The dam is a simple affair consisting of a concrete sill and apron in the river channel, surmounted by a series of 19 cast-iron gates between concrete abutments, and a long low gravel dike connecting with high ground on each side.

The present city of American Falls is located in southeastern Idaho, on the

Snake River, a few miles downstream from the point where the Port Neuf River enters. Here a great dam is to be constructed 100 feet high and one mile long. This dam will hold back some 3,000,000 acre-feet of water and the lake created will for this reason be the greatest of all irrigation reservoirs. This big dam alone will, it is estimated, cost some $15,000,000. The new lake will wipe out the city of American Falls, whose population is now around 1,000. However, this may very well be a benefit in disguise, as the present location is a low one, while, nearby, is a suitable elevated site. It is proposed to remove the city to this new ground at a cost of about $1,000,000. The dam is to be of the multiple-arch type. This type of dam makes use of a series of leaning arches. The forward thrust of the water, which tends in a vertical-face dam to overthrow it, is received by the convexity of the inclined arch and transferred to the foundation. In short, dependence is put, for resistance to the horizontal thrust, not so much upon the weight of the dam as upon this provision for transfer to the foundation itself.

Reference has been made to the Minidoka enterprise. A brief statement as to it will assist us to understand what may be expected of the general project. The head created by the damming of the waters of the Snake by the Minidoka structure is about 46 feet. The turbines are of the vertical type and have a runner diameter of 52½ inches. The water enters at the periphery, flows in towards the center and discharges rapidly. At 200 revolutions per minute the horse-power developed amounts to about 2,000 for each unit. Five turbines installed bring the capacity up to some 10,000 horse-power. The transmission line not so long ago was 31 miles long and distributed power at 33,000 volts to the several pumping stations. A number of sub-stations supply current to distributing concerns.

It will be of interest to note one or two problems that have to be solved in irrigating such regions as these along the Snake. On the north side, the Minidoka region is, in general, so flat that a problem arose as to how best to make the water flow over it. The solution adopted included building the dam rather high to provide for gravity flow. The highest ridges were accordingly selected for canal routes. The valley here slopes so gently that the canals could be allowed a down grade of only 0.0002.

Sand is a great absorber of water. A good deal of the land irrigated by the Minidoka enterprise is sandy or is underlaid by sand. There would naturally be great loss of water because of seepage into the subsoil unless some corrective could be applied. Perhaps the most practical thing in such cases is to fill up the subsoil until it can absorb no more. In some places 20 feet in depth have been saturated in order to cover the point. The application of the practice may result in bringing the ground water to the surface of other areas and in this way killing vegetation. Drainage had ultimately to be resorted to to get rid of certain unwanted water.

However, seepage losses required reduction. In the case of canals running over sandy sections, a good deal of water would leak away. At Minidoka, the procedure of silting was inaugurated. A good deal, probably the greatest part, of the water sent into the canal systems was clear. Otherwise, a natural, automatic process of silting would be set up. However, clear water can be made muddy. And this was the thing done. In less than two years, 112,000 cubic yards of silt were sluiced into the canal. The expense was about 20 cents per cubic yard. The main canal had been losing water by leakage at such a rate that after the mud had been introduced there was a saving of more than one-third the water. The silting material was clay.

Efficiency in Concrete Road Building

(*Continued from page 521*)

road, it leaves the surface with a smooth and even finish.

It should be explained that the movements of the tamper can be varied so as to give a violent or severe tamping. Thus, the tamping is done the first time over with a long and powerful stroke; the second time with a short, rapid stroke, which may be varied until the concrete has been subjected to continuous agitation. This is assisted by the fact that the whole machine during the tamping is traveling back and forth on the side forms—that is to say, in the direction of the axis of the road.

The Heavens in May, 1920

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currents very strong. But there are many other regions on the earth, such as the Bay of Fundy and the English Channel, where the tides must also exert a great deal of friction. It seems therefore probable that the friction of the tides, mainly in shallow arms of the sea and near the coasts, is great enough to account for the slowing of the earth's rotation, and the observed changes in the position of the moon.

The Heavens

At the hour chosen for our star-gazing we shall find Arcturus nearly on the meridian, and high up. The still brighter and redder object below him is the planet Mars. The bright star just below the latter to the right is Spica, which appears much dimmed by the planet's radiance.

Leo is the most conspicuous constellation in the west, and is rendered still brighter by the presence of Saturn, while Jupiter, lower down, lights up the inconspicuous regions of Cancer. Gemini and Auriga are setting in the northeast, with the Great and Little Bear and the Dragon high above the pole, while Cassiopeia and Cepheus are low in the north. Cygnus and Aquila have just risen, and Lyra is above them, with Hercules and Corona still higher. Ophiuchus and Serpens fill the southeast, and Scorpio is rising lower down.

The Planets

Mercury is a morning star at the beginning of May, and rises at 4:20 A. M. (All hours given here are, as usual, in standard time, and not in daylight-saving time).

Venus is a morning star, too, and is in conjunction with Mercury on the 13th, when the two planets are less than half a degree apart. They rise about 4:30 A. M. and should be visible in the dawn.

Mars is in Virgo, just past opposition and very bright, exceeding all the stars except Sirius. During the month he moves slowly westward and grows fainter as he recedes from us.

Jupiter is an evening star in Cancer, setting a little after midnight in the middle of the month. Saturn is in Leo, setting an hour and a quarter later than Jupiter.

Uranus is in just the opposite quarter of the heavens—being in quadrature on the same day as Saturn, but on the opposite side of the sun. He can be observed just before daybreak. Neptune is in Cancer, near Jupiter.

The moon is full at the time of the eclipse on the 2nd, in her last quarter at 1 A. M. on the 11th, new at 1 A. M. on the 18th, and in her first quarter at 4 P. M. on the 24th. She is nearest the earth on the 19th, and farthest away on the 6th. During her circuit of the sky she passes near Mars on the 1st, Uranus on the 12th, Venus and Mercury on the 17th, Jupiter on the 23rd, Saturn on the 25th, and Mars again on the 28th. The conjunctions with Venus and Mercury are close, and the three bodies will form a pretty group in the sky on the morning of the 17th.

PRINCETON UNIVERSITY OBSERVATORY.
April 19, 1920.